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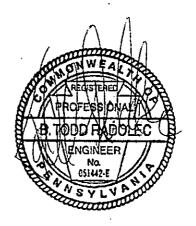
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# NEMACOLIN WOODLANDS RESORT CASINO TRAFFIC IMPACT STUDY

Wharton Township, Fayette County, Pennsylvania

December 2005

Prepared for: NWL COMPANY 1001 LaFayette Drive Farmington, PA 15445



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#### REFERENCE MATERIAL

- 1. Highway Capacity Software (HCS) Release 4.ld University of Florida.
- 2. Chapter 201 Engineering and Traffic Studies, Title 67 of the Pennsylvania Vehicle Code, Transportation, Pennsylvania Department of Transportation, December 1993.
- 3. Highway Capacity Manual, Transportation Research Board, Washington, D.C., 1997.
- 4. A Policy on geometric Design of Highways and Streets, 1990, American Association of State highway and Transportation Officials.
- 5. ITE Trip Generation Manual 7<sup>th</sup> Edition.
- 6. PennDOT Publication 282.

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#### **ABSTRACT**

On behalf of NWL Company, McMillen Engineering has performed a traffic impact study for the proposed Casino at Nemacolin Woodlands Resort. The project includes the converting the existing Woodlands Outdoor World into a Class 3 (resort) casino with 500 slot machines. Intersection analysis was performed for the main intersections along the Route 40 corridor from SR 381 to Dinner Bell Road. The project is located in Wharton Township, Fayette County, Pennsylvania.

The objective of this study is to analyze the impact of building conversion on the existing Route 40 Corridor. Base traffic data was compiled from counts conducted by McMillen Engineering during the weekday of August 12 – 13, 2005. This data was used to determine the capacity of the existing roads/ intersections and formed the basis for the recommended improvements.

Traffic analysis has been performed for weekday peak PM and Saturday peak hour traffic volumes for the opening day (2006) and future (2016) design years. All intersections shall operate at an adequate level of service to accommodate design volumes with the proposed roadway improvements. Recommended improvements resulting from the traffic impact study are as follows.

#### 1. Route 40 / Casino Main Driveway

Install medium volume signalized driveway with left turn lanes for both Route 40 approaches.

#### I. INTRODUCTION

On behalf of NWL Company, McMillen Engineering performed a traffic impact study-for-the proposed casino at Nemacolin Woodlands Resort. The project includes converting the existing Woodlands World into a Class 3 resort casino with 500 slot machines. Intersection analysis was performed for the main intersections along the Route 40 Corridor from SR 381 to Dinner Bell Road. The project is located in Wharton Township, Fayette County, Pennsylvania. The general influence area is based on a 30-mile radius from the site which contains five county areas of population outlined in Table 1.

The objective of this study is to analyze the impact of proposed development on the existing Route 40 corridor. This study has been conducted in accordance with PennDOT Publications 282 and traffic impact study guidelines established by the Institute of Transportation Engineers (ITE).

#### II. BASE TRAFFIC ANALYSIS

#### A. Study Area and Site Location

The project site is located in Wharton Township, Fayette County, Pennsylvania. The project site is described in Section II. B below. The project scope includes the analysis of the SR 0040 corridor from SR 381 to SR 2011 (Dinner Bell Road). The site is shown on the site location map (Figure 1). The study area for the analysis is shown on Figure 2.

The study area includes the existing seven (7) major intersections of SR 0040 and the proposed driveways at the site.

The existing intersections analyzed for this traffic impact study is as follows:

Route 40/SR 381 S

Route 40/SR 381 N

Route 40/Hawes Road

Route 40/Secondary Driveway

Route 40/Casino (main) Driveway and Marker Road

Route 40/Smith School Road

Route 40/SR 2011 (Dinner Bell Road)

#### B. Proposed Development

Proposed development consists of converting the existing 54,000 square-foot Outdoor Store Retail Facility into a 500 slot machine casino. The facility shall be governed by the Pennsylvania Gaming Control Board regulations currently under development. The development components of the proposed development are outlined in Table 2.

	BLE 1 LATION DATA
City / County	2000 Census*
Uniontown	12,422
Fayette	148,644
Westmoreland	369,993
Washington	202,897
Greene	40,672
Somerset	80,023

<sup>\*2000</sup> census population (critical) used in traffic distribution calculations.

TABLE 2 DEVELOPMENT COMPONENTS TRAFFIC IMPACT STUDY					
ITE Number	Development Component	Description			
473	Casino	500 slots			
815	Outdoor Store	54,000 sf			

#### TABLE 3

#### PROJECTED TRIP GENERATION

#### NEMACOLIN WOODLANDS RESORT CASINO

Wharton Township, Fayette County, Pennsylvania

Prepared by: McMillen Engineering Inc.

#### PROJECTED VEHICLE TRIP GENERATION (1)

				Weekda	y Peak PN	/ Hour (3)	Saturday	Peak Ho	ur (4)
Development Component	Size	ITE Code (5)	Average Weekday Daily Traffic (2)	Enter	Exit	Total	Enter	Exit	Total
Casino	500 slots	473		155	140	295	170	150	320
Outdoor Store	54,000sf	815	3000	148	147	295	208	201	409

- (1) Trip generation rates based on Institute of Transportation Engineers, Trip Generation Manual 7th edition and Information provided by PADOT 12-0.
- (2) Average weekday daily traffic volumes projected to be generated during a typical weekday (total trips entering and exiting)
- (3) Trips shown for weekday PM peak hour of generator. The projected trips are applied to the peak hour of adjacent street traffic.
- (4) Trips shown for saturday peak hour of generator. The projected trips are applied to the peak hour of adjacent street traffic.
- (5) ITE land use code from Institute of Transportation Engineers, Trip Generation Manual 7th edition

#### C. Traffic Analysis

SPC has projected traffic growth of 1% based upon projected growth of adjacent developments for the surrounding areas. Base trip data was compiled by McMillen Engineering on August 12 – 13, 2005. Manual counters were utilized to obtain movement counts along the SR 0040 corridor See Appendix 1 for traffic count data. Computer analysis was performed utilizing the HCS Release 4.1d. The scenarios analyzed in the study are as follows:

- 1 2006 Weekday Peak PM Hour Base Conditions
- 2 2006 Saturday Peak Hour Base Conditions
- 3 2006 Weekday Peak PM with Development Conditions
- 4 2006 Saturday Peak Hour with Development Conditions
- 5 2016 Weekday Peak PM Hour Base Conditions
- 6 2016 Saturday Peak Hour Base Conditions
- 7 2016 Weekday Peak PM Hour with Development Conditions
- 8 2016 Saturday Peak Hour with Development Conditions

The analysis considers the Weekday PM Peak and the Saturday Peak hour traffic volumes, turning movement data collection, projections of the future development, intersection capacity analysis and left-turn warrant evaluation and safety considerations. Based upon these parameters, findings of the analysis are listed in the following section.

Figures 4 and 5A-B outline the transportation plan and the distribution of the generated traffic.

#### D. Traffic Impact Study Findings

The following approach levels of service (LOS) were observed for each study intersection.

#### 1. SR 0040 /SR 0381 S

- LOS E- Weekday PM peak hour 2006 conditions without development
- LOS E- Weekday PM peak hour 2006 conditions with development
- LOS D- Saturday peak hour 2006 conditions without development
- LOS C- Saturday peak hour 2006 conditions with development
- LOS F- Weekday PM peak hour 2016 conditions without development
- LOS F- Weekday PM peak hour 2016 conditions with development
- LOS E- Saturday peak hour 2016 conditions without development
- LOS E- Saturday peak hour 2016 conditions with development

#### SR 0040 / SR 0381 N

- LOS D- Weekday PM peak hour 2006 conditions without development
- LOS D- Weekday PM peak hour 2006 conditions with development
- LOS E- Saturday peak hour 2006 conditions without development
- LOS D- Saturday peak hour 2006 conditions with development
- LOS E- Weekday PM peak hour 2016 conditions without development
- LOS E- Weekday PM peak hour 2016 conditions with development
- LOS F- Saturday peak hour 2016 conditions without development
- LOS E- Saturday peak hour 2016 conditions with development

#### 3. SR 0040 / Hawes Road

- LOS C- Weekday PM peak hour 2006 conditions without development
- LOS C--Weekday-PM peak hour 2006 conditions with development
- LOS C- Saturday peak hour 2006 conditions without development
- LOS C- Saturday peak hour 2006 conditions with development.
- LOS D- Weekday PM peak hour 2016 conditions without development
- LOS D- Weekday PM peak hour 2016 conditions with development
- LOS C- Saturday peak hour 2016 conditions without development
- LOS C- Saturday peak hour 2016 conditions with development

#### 4. SR 0040 / Secondary Driveway

- LOS -- Weekday PM peak hour 2006 conditions without development
- LOS C- Weekday PM peak hour 2006 conditions with development
- LOS -- Saturday peak hour 2006 conditions without development
- LOS C- Saturday peak hour 2006 conditions with development
- LOS -- Weekday PM peak hour 2016 conditions without development
- LOS C- Weekday PM peak hour 2016 conditions with development
- LOS -- Saturday peak hour 2016 conditions without development
- LOS C- Saturday peak hour 2016 conditions with development

#### 5. SR 0040 / Casino (main) Driveway and Marker Road

- LOS B- Weekday PM peak hour 2006 conditions without development
- LOS B-Weekday PM peak hour 2006 conditions with development
- LOS C- Saturday peak hour 2006 conditions without development
- LOS B- Saturday peak hour 2006 conditions with development
- LOS C- Weekday PM peak hour 2016 conditions without development
- LOS B- Weekday PM peak hour 2016 conditions with development
- LOS C- Saturday peak hour 2016 conditions without development
- LOS B- Saturday peak hour 2016 conditions with development

#### 6. SR 0040 / Smith School House Road

- LOS C- Weekday PM peak hour 2006 conditions without development
- LOS C- Weekday PM peak hour 2006 conditions with development
- LOS C- Saturday peak hour 2006 conditions without development
- LOS C- Saturday peak hour 2006 conditions with development
- LOS C- Weekday PM peak hour 2016 conditions without development
- LOS C- Weekday PM peak hour 2016 conditions with development
- LOS C- Saturday peak hour 2016 conditions without development
- LOS C- Saturday peak hour 2016 conditions with development

#### 7. SR 0040 / SR 2011 (Dinner Bell Road)

- LOS D- Weekday PM peak hour 2006 conditions without development
- LOS D- Weekday PM peak hour 2006 conditions with development
- LOS C- Saturday peak hour 2006 conditions without development
- LOS C- Saturday peak hour 2006 conditions with development
- LOS E- Weekday PM peak hour 2016 conditions without development
- LOS E- Weekday PM peak hour 2016 conditions with development
- LOS D- Saturday peak hour 2016 conditions without development
- LOS D- Saturday peak hour 2016 conditions with development

#### III. EXISTING TRANSPORTATION SYSTEM

#### A. - — Traffic Impact Study Area

The study area considers the SR 0040 Corridor between SR 0381 and SR 2011. It encompasses seven (7) existing un-signalized intersections and one proposed signalized intersection.

#### B. Existing Road Network

SR 0040 runs east and west with the majority of the traffic from the adjacent developments traveling the corridor. Local roads will have minimal trips and minimal affect from the proposed conversion of the existing facility into the casino.

#### C. Existing Traffic Volume Peak Hours

Data was collected for turning movements in the study area during Friday and Saturday peak hours. The study considers the weekday PM and Saturday peak periods.

	TABLE 4 PEAK HOUR SUMMARY	
Intersection	Peak Weekday PM	Peak Saturday PM
All	4:45 - 5:45	10:45 – 11:45

#### D. Improvements Proposed by Others

At this time no roadway improvements are proposed for the SR 0040 Corridor within the study area. A Needs Study is being considered to upgrade SR. 0040 from SR 0381 to SR 2011.

#### E. Traffic Signal Warrant Analysis

The need for a traffic signal at a particular intersection is based upon criteria in Chapter 201, Engineering and Traffic Studies<sup>2</sup>, of the Pennsylvania Code, Title 67, under traffic Signal Warrants, Signalization is based on factors such as traffic volumes, vehicular movements, capacity analysis, speed data, and accident analysis. One or more of the traffic signal warrants must be met to justify a traffic signal.

A traffic signal warrant analysis has been performed for the intersection. The site driveway does warrant a traffic signal.

Results of the Warrant Analysis are presented in Appendix 8.

#### F. Highway Capacity Analysis

The Highway Capacity Manual<sup>3</sup> defines capacity analysis as a set of procedures used to estimate the traffic-carrying ability of a facility over a range of defined operational conditions. The operations conditions are described in terms of a letter from "A" to "F" with "A" being the most desirable

condition. A description of the various levels of service is outlined in the Highway Capacity Manual.

The level of service at signalized intersections measures the average stop delay time per vehicle and also the volume to capacity ratio as it relates to the specific intersection. The capacity ratio compares the peak hour traffic volumes to the theoretical maximum traffic volumes that the facility can accommodate.

The level of service for an un-signalized intersection measures the delay to turning traffic to find a gap in a major street traffic flow to allow for the successful completion of the desired turning movement. The critical movements at un-signalized intersections are left turns on the main streets and left turns on the side streets.

Capacity analyses were performed for the weekday PM and Saturday Peak periods at the study intersections. The capacity analysis results are provided in detail in Appendix 2 through 5.

Capacity analyses were performed for 2006 and 2016 weekday peak PM and Saturday peak periods. Results of the analysis are compared for base and developed conditions. Summaries of the traffic volume and levels of service are presented in Figures 6-9 and Table 5.

#### G. Queue Analysis

See Appendix 7 for the queue analysis for the left turn lanes to be added as a result of this development:

#### H. Peak Hour Factors

Peak hour factors were calculated for the weekday PM and Saturday peak hours of traffic volume. The peak hours are based upon the peak fifteen minute volumes observed for each of the peak hour periods. Calculations are provided in Appendix 6.

### TABLE 5 INTERSECTION LEVEL OF SERVICE SUMMARY -- 2006 CONDITIONS WITHOUT DEVELOPMENT ROUTE 40

Wharton Township, Fayette County, Pennsylvania Prepared by: McMillen Engineering Inc.

11000100	1 topared by: Mortinon Engineering ine:				
	Level of Service/Average Seconds of Delay				
	(Signalized Intersections) or Reserve Capacity				
	(Un-signalized	Intersections)			
	2006 Conditions Without Development				
Intersection/Approach/Movement	Weekday Peak PM	Saturday Peak Hour			
Route 40 and SR 381S					
Route 40 Westbound					
Left Turns and Throughs	A/9.1	A/9.6			
Approach					
SR 381S Northbound					
Left and Right Turns	E/37.8	D/27.7			
Approach	E/37.8	D/27.7			

# TABLE 5 INTERSECTION LEVEL OF SERVICE SUMMARY 2006 CONDITIONS WITH DEVELOPMENT ROUTE 40 Wharton Township, Fayette County, Pennsylvania Prepared by McMillen Engineering Inc. Level of Service/Average Seconds of Delay

(Signalized Intersections) or Reserve Capacity (Un-signalized Intersections) 2006 Conditions With Development Saturday Peak Hour Intersection/Approach/Movement Weekday Peak PM Route 40 and SR 381S Route 40 Westbound Left Turns and Throughs A/9.0 A/9.4 Approach SR 381S Northbound Left and Right Turns E/36.4 C/24.9 Approach E/36.4 C/24.9

### TABLE 5 INTERSECTION LEVEL OF SERVICE SUMMARY

### 2006 CONDITIONS WITHOUT DEVELOPMENT ROUTE 40

Wharton Township, Fayette County, Pennsylvania
Prepared by: McMillen Engineering Inc.

Prepared by: McMillen Engineering Inc.				
	Level of Service/Average Seconds of Delay			
	(Signalized Intersections) or Reserve Capacity			
	(Un-signalized Intersections)			
	2006 Conditions Without Development			
Intersection/Approach/Movement	Weekday Peak PM	Saturday Peak Hour		
Route 40 and SR 381N				
Route 40 Eastbound				
Left Turns and Throughs	A/8.9	A/8.9		
Approach				
,				
SR 381N Southbound				
Left and Right Turns	D/29.0	E/35.5		
Approach	D/29.0	E/35.5		

# TABLE 5 INTERSECTION LEVEL OF SERVICE SUMMARY 2006 CONDITIONS WITH DEVELOPMENT ROUTE 40

	Level of Service/Average Seconds of Delay (Signalized Intersections) or Reserve Capacity (Un-signalized Intersections) 2006 Conditions With Development		
Intersection/Approach/Movement	Weekday Peak PM	Saturday Peak Hour	
Route 40 and SR 381N			
Route 40 Eastbound			
Left Turns and Throughs	A/8.9	A/8.7	
Approach			
SR381N Southbound			
Left and Right Turns	D/29.5	D/29.8	
Approach	D/29.5	D/29.8	

# TABLE 5 INTERSECTION LEVEL OF SERVICE SUMMARY 2006 CONDITIONS WITHOUT DEVELOPMENT ROUTE 40

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	Level of Service/Average Seconds of Delay (Signalized Intersections) or Reserve Capacity (Un-signalized Intersections) 2006 Conditions Without Development		
•			
Intersection/Approach/Movement	Weekday Peak PM	Saturday Peak Hour	
Route 40 and Hawes Road			
Route 40 Eastbound			
Left Turns and Throughs	A/8.4	A/8.5	
Approach			
Hawes Road Southbound			
Left and Right Turns	C/20.9	C/20.9	
Approach	C/20.9	C/20.9	

	TABLE 5				
INTERSECTION LEVEL OF SERVICE SUMMARY					
2006 CONE	2006 CONDITIONS WITH DEVELOPMENT				
	ROUTE 40				
	ship, Fayette County, Penn				
Prepared	by: McMillen Engineering I				
		rage Seconds of Delay			
		ns) or Reserve Capacity			
	(Un-signalized Intersections)				
	2006 Conditions	With Development			
Intersection/Approach/Movement	Weekday Peak PM	Saturday Peak Hour			
Route 40 and Hawes Road					
Route 40 Eastbound					
Left Turns and Throughs	A/8.3	A/8.3			
Approach	Approach				
Hawes Road Southbound					
Left and Right Turns C/20.6 C/19.3					
Approach C/20.6 C/19.3					

## TABLE 5 INTERSECTION LEVEL OF SERVICE SUMMARY 2006 CONDITIONS WITHOUT DEVELOPMENT ROUTE 40

Prepared by: McWillien Engineering Inc.				
	Level of Service/Average Seconds of Delay			
	(Signalized Intersections) or Reserve Capacity			
	(Un-signalized Intersections)			
	2006 Conditions Without Development			
Intersection/Approach/Movement	Weekday Peak PM	Saturday Peak Hour		
Route 40 and Secondary Driveway	/			
Route 40 Eastbound	Route 40 Eastbound			
Left Turns and Throughs	Left Turns and Throughs			
Approach				
Secondary Driveway				
Southbound				
Left and Right Turns	<u>.</u>			
Approach				

	TABLE 5				
INTERSECTION LEVEL OF SERVICE SUMMARY					
2006 COND	ITIONS WITH DEVELOPM	1ENT			
	ROUTE 40	-			
Wharton Towns	ship, Fayette County, Penn	sylvania			
Prepared	by: McMillen Engineering I	nc			
	Level of Service/Average Seconds of Delay				
İ		ns) or Reserve Capacity			
	(Un-signalized Intersections)				
	2006 Conditions With Development				
Intersection/Approach/Movement	Weekday Peak PM Saturday Peak Hour				
Route 40 and Secondary Driveway	/				
Route 40 Eastbound					
Left Turns and Throughs	A/8.3	A/8.2			
Approach					
Secondary Driveway	Secondary Driveway				
Southbound					
Left and Right Turns	C/15.1	C/15.1			
Approach	C/15.1	C/15.1			

### TABLE 5 INTERSECTION LEVEL OF SERVICE SUMMARY 2006 CONDITIONS WITHOUT DEVELOPMENT

**ROUTE 40** 

	Level of Service/Average Seconds of Delay (Signalized Intersections) or Reserve Capacity (Un-signalized Intersections) 2006 Conditions Without Development Weekday Peak PM Saturday Peak Hour		
Intersection/Approach/Movement			
	Route 40 and Marker Road/Main Driveway		
Route 40 Westbound			
Left Turns and Throughs	A/8.8	A/9.0	
Approach			
Marker Road Northbound			
Left and Right Turns	B/14.3	C/16.0	
Approach	B/14.3	C/16.0	

# TABLE 5 INTERSECTION LEVEL OF SERVICE SUMMARY 2006 CONDITIONS WITH DEVELOPMENT ROUTE 40

Prepared by: Micivillen Engineering Inc.		
	Level of Service/Average Seconds of Delay	
	(Signalized Intersections) or Reserve Capacity	
		Intersections)
		With Development
Intersection/Approach/Movement	Weekday Peak PM	Saturday Peak Hour
Route 40 and Marker Road/Main D	Driveway	
Route 40 Eastbound		
Left Turns	C/31.1	C/31.5
Right Turns and Throughs	B/16.2	B/14.7
Approach	B/17.9	B/17.0
Route 40 Westbound		
Left Turns	C/28.6	C/28.5
Right Turns and Throughs	B/13.4	B/12.9
Approach	B/13.7	B/13.2
Marker Road Northbound		
Left, Right Turns and Throughs	C/24.3	C/24.2
Approach	C/24.3	C/24.2
Main Driveway Southbound		
Left Turns	C/25.2	C/25.3
Right Turns and Throughs	C/25.1_	C/25.2
Approach	C/25.2	C/25.3
Entire Intersection LOS	B/17.0	B/16.4

#### TABLE 5 INTERSECTION LEVEL OF SERVICE SUMMARY 2006 CONDITIONS WITHOUT-DEVELOPMENT **ROUTE 40** Wharton Township, Fayette County, Pennsylvania Prepared by: McMillen Engineering Inc. Level of Service/Average Seconds of Delay (Signalized Intersections) or Reserve Capacity (Un-signalized Intersections) 2006 Conditions Without Development Saturday Peak Hour Weekday Peak PM Intersection/Approach/Movement Route 40' and Smith School Road Route 40 Eastbound Left Turns and Throughs A/8.3 A/8.4 Approach

C/15.3 C/15.3 C/17.5

C/17.5

	TABLE 5	
INTERSECTION LEVEL OF SERVICE SUMMARY		
	ITIONS WITH DEVELOPM	
2000 00112	ROUTE 40	
Wharton Town	ship, Fayette County, Penn	sylvania
	by: McMillen Engineering I	
, robarou		age Seconds of Delay
		ns) or Reserve Capacity
	(Un-signalized Intersections)	
<i>'</i>	2006 Conditions With Development	
Intersection/Approach/Movement	Weekday Peak PM	Saturday Peak Hour
Route 40 and Smith School Road		
Route 40 Eastbound		
Left Turns and Throughs	A/8.2	A/8.5
Approach		
Smith School Road Southbound		
Left and Right Turns	C/15.1	C/18.7
Approach	C/15.1	C/18.7

Smith School Road Southbound

Left and Right Turns

Approach

# TABLE 5 INTERSECTION LEVEL OF SERVICE SUMMARY 2006 CONDITIONS WITHOUT-DEVELOPMENT--ROUTE 40

Prepared by: McWillen Engineering Inc.		
	Level of Service/Average Seconds of Delay	
	(Signalized Intersections) or Reserve Capacity	
		Intersections)
	2006 Conditions Without Development	
Intersection/Approach/Movement	Weekday Peak PM	Saturday Peak Hour
Route 40 and Dinner Bell Road		
Route 40 Eastbound		
Left, Right Turns and Throughs	A/8.3	A/8.2
Approach		·
Route 40 Westbound		
Left, Right Turns and Throughs	A/8.8	A/8.8
Approach		
Dinner Bell Road Northbound		
Left, Right Turns and Throughs	D/27.8	D/33.8
Approach	D/27.8	D/33.8
Dinner Bell Road Southbound		
Left, Right Turns and Throughs	D/31.9	C/24.9
Approach	D/31.9	C/24.9

#### TABLE 5 \_

### INTERSECTION LEVEL OF SERVICE SUMMARY 2006 CONDITIONS WITH DEVELOPMENT ROUTE 40

Prepared by: McMillen Engineering Inc.		
	Level of Service/Average Seconds of Delay	
,	(Signalized Intersections) or Reserve Capacity	
	(Un-signalized Intersections)	
	2006 Conditions With Development	
Intersection/Approach/Movement	Weekday Peak PM	Saturday Peak Hour
Route 40 and Dinner Bell Road		
Route 40 Eastbound	<u> </u>	
Left, Right Turns and Throughs	A/8.3	A/8.1
Approach		
Route 40 Westbound		
Left, Right Turns and Throughs	A/8.7	A/8.7
Approach		
Dinner Bell Road Northbound		
Left, Right Turns and Throughs	D/27.2	D/30.3
Approach	D/27.2	D/30.3
Dinner Bell Road Southbound		
Left, Right Turns and Throughs	D/31.2	C/23.0
Approach	D/31.2	C/23.0

	TABLE		
TABLE 5			
1 '	INTERSECTION LEVEL OF SERVICE SUMMARY		
2016 CONDIT	IONS WITHOUT DEVELOR	PMENT	
	ROUTE-40		
Wharton Town	ship, Fayette County, Penn	sylvania	
Prepared	by: McMillen Engineering I		
	Level of Service/Aver	age Seconds of Delay	
	(Signalized Intersection	ns) or Reservé Capacity	
	(Un-signalized Intersections)		
ļ ļ	2016 Conditions Without Development		
Intersection/Approach/Movement	Weekday Peak PM Saturday Peak Hour		
Route 40 and SR 381S			
Route 40 Westbound			
Left Turns and Throughs	A/9.4	B/10.0	
Approach			
SR 381S Northbound			
Left and Right Turns	F/59.3	E/38.0	
Approach	F/59.3	E/38.0	

<del></del>			
TABLE 5			
	INTERSECTION LEVEL OF SERVICE SUMMARY		
2016 CONE	DITIONS WITH DEVELOPM	1ENT	
	ROUTE 40		
	ship, Fayette County, Penn		
Prepared	by: McMillen Engineering I		
		age Seconds of Delay	
	(Signalized Intersections) or Reserve Capacity		
	(Un-signalized Intersections)		
	2016 Conditions With Development		
Intersection/Approach/Movement	Weekday Peak PM Saturday Peak Hour		
Route 40 and SR 381S			
Route 40 Westbound			
Left Turns and Throughs	A/9.3	A/9.8	
Approach			
SR 381S Northbound			
Left and Right Turns	F/56.6	D/32.9	
Approach	F/56.6	D/32.9	

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### TABLE 5 INTERSECTION LEVEL OF SERVICE SUMMARY 2016 CONDITIONS WITHOUT DEVELOPMENT

**ROUTE 40** 

	Level of Service/Average Seconds of Delay (Signalized Intersections) or Reserve Capacity (Un-signalized Intersections) 2016 Conditions Without Development	
Intersection/Approach/Movement	Weekday Peak PM	Saturday Peak Hour
Route 40 and SR 381N		
Route 40 Eastbound		
Left Turns and Throughs	A/9.2	A/9.1
Approach		
SR 381N Southbound		
Left and Right Turns	E/41.6	F/53.3
Approach	E/41.6	F/53.3

	TABLE 5		
INTERSECTION LEVEL OF SERVICE SUMMARY			
1	DITIONS WITH DEVELOPM		
2010 00112	ROUTE 40	ILINI	
Wharton Town	· · · - · · ·	outronia	
	ship, Fayette County, Penn by: McMillen Engineering li		
riepared			
		rage Seconds of Delay	
ļ	(Signalized Intersections) or Reserve Capacity		
ł	(Un-signalized Intersections)		
	2016 Conditions With Development		
Intersection/Approach/Movement	Weekday Peak PM	Saturday Peak Hour	
Route 40 and SR 381N			
Route 40 Eastbound			
Left Turns and Throughs	A/9.1	A/8.9	
Approach			
SR381N Southbound			
Left and Right Turns	E/41.3	E/42.2	
Approach	E/41.3	E/42.2	

## TABLE 5 INTERSECTION LEVEL OF SERVICE SUMMARY 2016 CONDITIONS WITHOUT DEVELOPMENT ROUTE 40

Wharton Township, Fayette County, Pennsylvania Prepared by: McMillen Engineering Inc.

	<u> </u>	
	Level of Service/Average Seconds of Delay (Signalized Intersections) or Reserve Capacity (Un-signalized Intersections) 2016 Conditions Without Development	
Intersection/Approach/Movement	Weekday Peak PM	Saturday Peak Hour
Route 40 and Hawes Road		
Route 40 Eastbound		
Left Turns and Throughs	A/8.6	A/8.7
Approach		
Hawes Road Southbound	<del> </del>	
Left and Right Turns	D/25.9	C/24.7
Approach	D/25.9	C/24.7

# TABLE 5 INTERSECTION LEVEL OF SERVICE SUMMARY 2016 CONDITIONS WITH DEVELOPMENT ROUTE 40 Wharton Township, Fayette County, Pennsylvania Prepared by: McMillen Engineering Inc. Level of Service/Average Seconds of Delay

(Signalized Intersections) or Reserve Capacity (Un-signalized Intersections) 2016 Conditions With Development Intersection/Approach/Movement Weekday Peak PM Saturday Peak Hour Route 40 and Hawes Road Route 40 Eastbound Left Turns and Throughs A/8.5 A/8.5 Approach Hawes Road Southbound Left and Right Turns D/25.6 C/22.8 Approach D/25.6 C/22.8

#### TABLE 5 INTERSECTION LEVEL OF SERVICE SUMMARY 2016 CONDITIONS WITHOUT DEVELOPMENT ROUTE 40. Wharton Township, Fayette County, Pennsylvania Prepared by: McMillen Engineering Inc. Level of Service/Average Seconds of Delay (Signalized Intersections) or Reserve Capacity (Un-signalized Intersections) 2016 Conditions Without Development Weekday Peak PM Saturday Peak Hour Intersection/Approach/Movement Route 40 and Secondary Driveway Route 40 Eastbound Left Turns and Throughs

#### TABLE 5 INTERSECTION LEVEL OF SERVICE SUMMARY 2016 CONDITIONS WITH DEVELOPMENT **ROUTE 40** Wharton Township, Fayette County, Pennsylvania Prepared by: McMillen Engineering Inc. Level of Service/Average Seconds of Delay (Signalized Intersections) or Reserve Capacity (Un-signalized Intersections) 2016 Conditions With Development Weekday Peak PM Saturday Peak Hour Intersection/Approach/Movement Route 40 and Secondary Driveway Route 40 Eastbound Left Turns and Throughs A/8.4 A/8.6 Approach Secondary Driveway Southbound Left and Right Turns C/16.5 C/18.7 Approach C/16.5 C/18.7

Approach

Southbound

Approach

Secondary Driveway

Left and Right Turns

#### TABLE 5

#### INTERSECTION LEVEL OF SERVICE SUMMARY 2016 CONDITIONS WITHOUT DEVELOPMENT **ROUTE 40**

Wharton Township, Fayette County, Pennsylvania			
Prepared by: McMillen Engineering Inc.			
_	Level of Service/Average Seconds of Delay		
	(Signalized Intersection	ns) or Reserve Capacity	
	(Un-signalized	d Intersections)	
	2016 Conditions Without Development		
Intersection/Approach/Movement	Weekday Peak PM	Saturday Peak Hour	
Route 40 and Marker Road/Main Driveway			
Route 40 Westbound			
Left Turns and Throughs	A/9.0	A/9.3	
Approach			
Marker Road Northbound			
Left and Right Turns	C/15.2	C/17.1	
Approach	C/15.2	C/17.1	

#### TABLE 5 INTERSECTION LEVEL OF SERVICE SUMMARY 2016 CONDITIONS WITH DEVELOPMENT **ROUTE 40**

Wharton Township, Fayette County, Pennsylvania

Prepared by: McMillen Engineering Inc. Level of Service/Average Seconds of Delay (Signalized Intersections) or Reserve Capacity (Un-signalized Intersections) 2016 Conditions With Development Intersection/Approach/Movement Weekday Peak PM Saturday Peak Hour Route 40 and Marker Road/Main Driveway Route 40 Eastbound Left Turns C/31.1 C/31.5 Right Turns and Throughs B/18.6 B/16.3 B/19.8 B/18.1 Approach Route 40 Westbound Left Turns C/28.6 C/28.6 Right Turns and Throughs B/14.2 B/13.5 B/14.5 B/13.8 Approach Marker Road Northbound Left, Right Turns and Throughs C/24.3 C/24.2 C/24.3 C/24.2 Approach Main Driveway Southbound C/25.2 Left Turns C/25.3 Right Turns and Throughs C/25.1 C/25.3 Approach C/25.2 C/25.3 Entire Intersection LOS B/18.3 B/17.2

		<u> </u>
TABLE 5		
INTERSECTION LEVEL OF SERVICE SUMMARY		
2016 CONDIT	TIONS WITHOUT DEVELOF	PMENT
	ROUTE 40	
Wharton Towns	ship, Fayette County, Penn:	sylvania
Prepared	by: McMillen Engineering Ir	nc
	Level of Service/Aver	age Seconds of Delay
		ns) or Reserve Capacity
	(Un-signalized Intersections)	
	2016 Conditions Without Development	
Intersection/Approach/Movement	Weekday Peak PM	Saturday Peak Hour
Route 40 and Smith School Road		
Route 40 Eastbound		
Left Turns and Throughs	A/8.4	A/8.6
Approach		
Smith School Road Southbound		
Left and Right Turns	C/16.7	C/20.0
Approach	C/16.7	C/20.0

TABLE 5				
INTERSECTION LEVEL OF SERVICE SUMMARY				
2016 CONDITIONS WITH DEVELOPMENT				
ROUTE 40				
Wharton Township, Fayette County, Pennsylvania				
Prepared by: McMillen Engineering Inc.				
	Level of Service/Average Seconds of Delay			
	(Signalized Intersections) or Reserve Capacity			
	(Un-signalized Intersections)			
	2016 Conditions With Development			
Intersection/Approach/Movement	Weekday Peak PM	Saturday Peak Hour		
Route 40 and Smith School Road				
Route 40 Eastbound				
Left Turns and Throughs	A/8.4	A/8.5		
Approach				
Smith School Road Southbound				
Left and Right Turns	C/16.4	C/18.9		
Approach	C/16.4	C/18.9		

#### TABLE 5 INTERSECTION LEVEL OF SERVICE SUMMARY 2016 CONDITIONS WITHOUT DEVELOPMENT **ROUTE 40**

Wharton Township, Fayette County, Pennsylvania			
Prepared	by: McMillen Engineering Ir		
	Level of Service/Average Seconds of Delay		
1	(Signalized Intersections) or Reserve Capacity		
	(Un-signalized Intersections)		
	2016 Conditions Without Development		
Intersection/Approach/Movement	Weekday Peak PM	Saturday Peak Hour	
Route 40 and Dinner Bell Road			
Route 40 Eastbound			
Left, Right Turns and Throughs	A/8.4	A/8.4	
Approach			
Route 40 Westbound			
Left, Right Turns and Throughs	A/9.0	A/9.0	
Approach			
Dinner Bell Road Northbound			
Left, Right Turns and Throughs	E/35.3	E/48.4	
Approach	E/35.3	E/48.4	
Dinner Bell Road Southbound			
Left, Right Turns and Throughs	E/44.4	D/31.8	
Approach	E/44.4	D/31.8	

#### TABLE 5

#### INTERSECTION LEVEL OF SERVICE SUMMARY 2016 CONDITIONS WITH DEVELOPMENT ROUTE 40

orne, rayono ocurry, roms	oyirana	
by: McMillen Engineering Ir	nc.	
Level of Service/Average Seconds of Delay		
(Signalized Intersections) or Reserve Capacity (Un-signalized Intersections)		
Weekday Peak PM	Saturday Peak Hour	
A/8.4	A/8.3	
A/8.9	A/8.9	
·····		
<del></del>	E/41.8	
D/34.6	E/41.8	
E/42.8	D/28.7	
E/42.8	D.28.7	
	by: McMillen Engineering In Level of Service/Aver (Signalized Intersection (Un-signalized 2016 Conditions) Weekday Peak PM  A/8.4  A/8.9  D/34.6  D/34.6	

#### IV. DESIGN CONDITIONS

#### A. Design Year and Assumptions

The future year of 2016 was selected as the design year based upon the PaDOT policy of designing improvements for ten years beyond the proposed development. Additional assumptions include the traffic growth rate, current Transportation Improvement Program (TIP) items, and traffic volumes generated by other developments in the study area or close vicinity.

The traffic growth rate was obtained from the Southwestern Pennsylvania Regional Planning Commission (SPC).

#### B. <u>Left-Turn Lane Analysis</u>

The need for left turn lanes at each of the study intersections were evaluated based on the criteria proved in the Intersection Channelization Guide, NCHRP Report 279, published by the Transportation Research Board. The proposed site driveway meets the requirements of a left turn lane.

C. <u>Development Scenarios on Proposed Roadway Improvements</u>
The recommended roadway improvements outlined in Section IV D and shown in Figure 3 were developed based on projected full development.

Final roadway improvement details will be determined as part of final development and design.

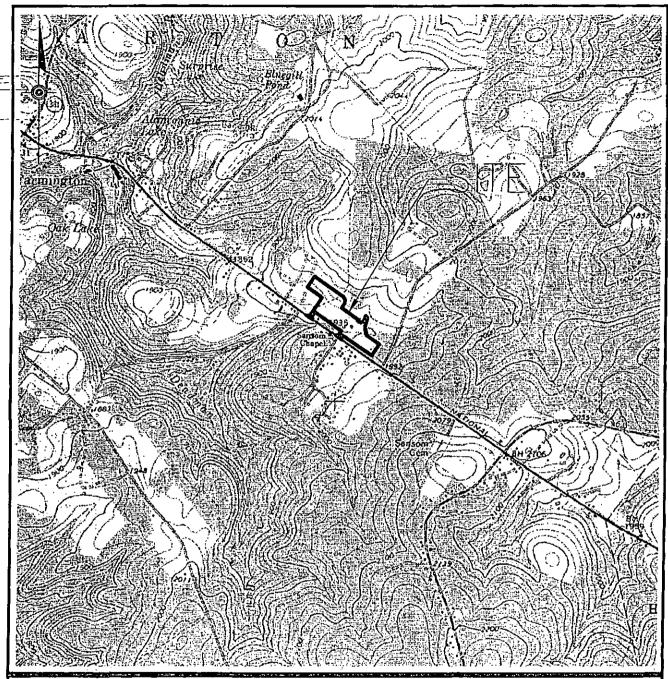
#### D. Recommendations

McMillen Engineering recommends the improvements to the corridor as outlined in the analysis and this report. The improvements include:

#### 1. SR 0040 / Casino (Main) Driveway

> Install medium volume signalized driveway with left turn lanes for both Route 40 approaches.

### **FIGURES**



QUADRANGLE: FORT NECESSITY, PA

SCALE: 1"=2000'

USGS LOCATION MAP

FIGURE 1

#### NWL - OUTDOOR STORE RENOVATION

Wharton Township

Fayette County

Pennsylvania

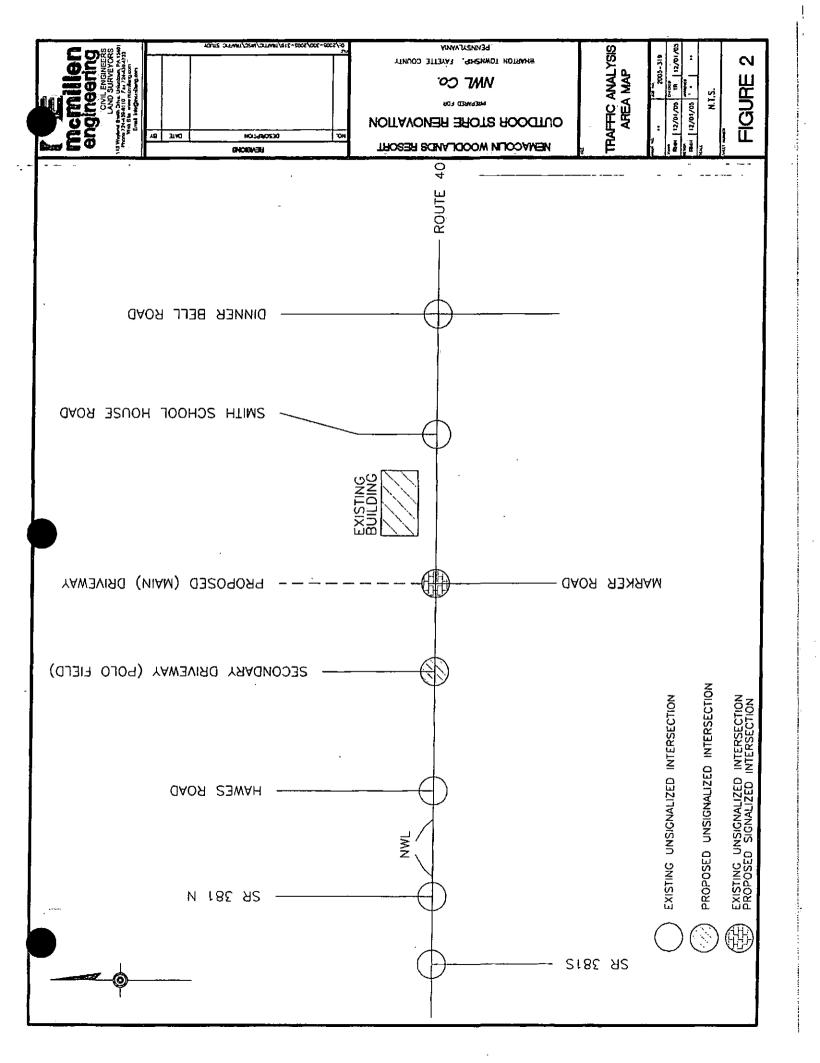
Prepared by

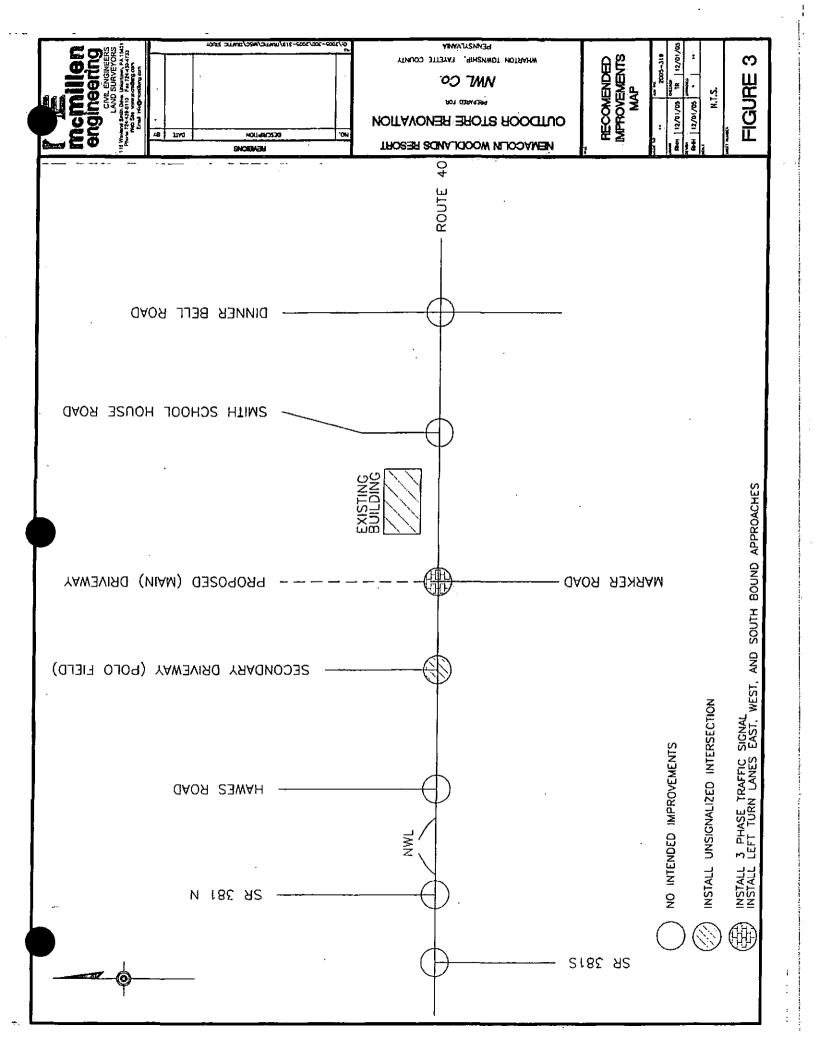
McMILLEN ENGINEERING

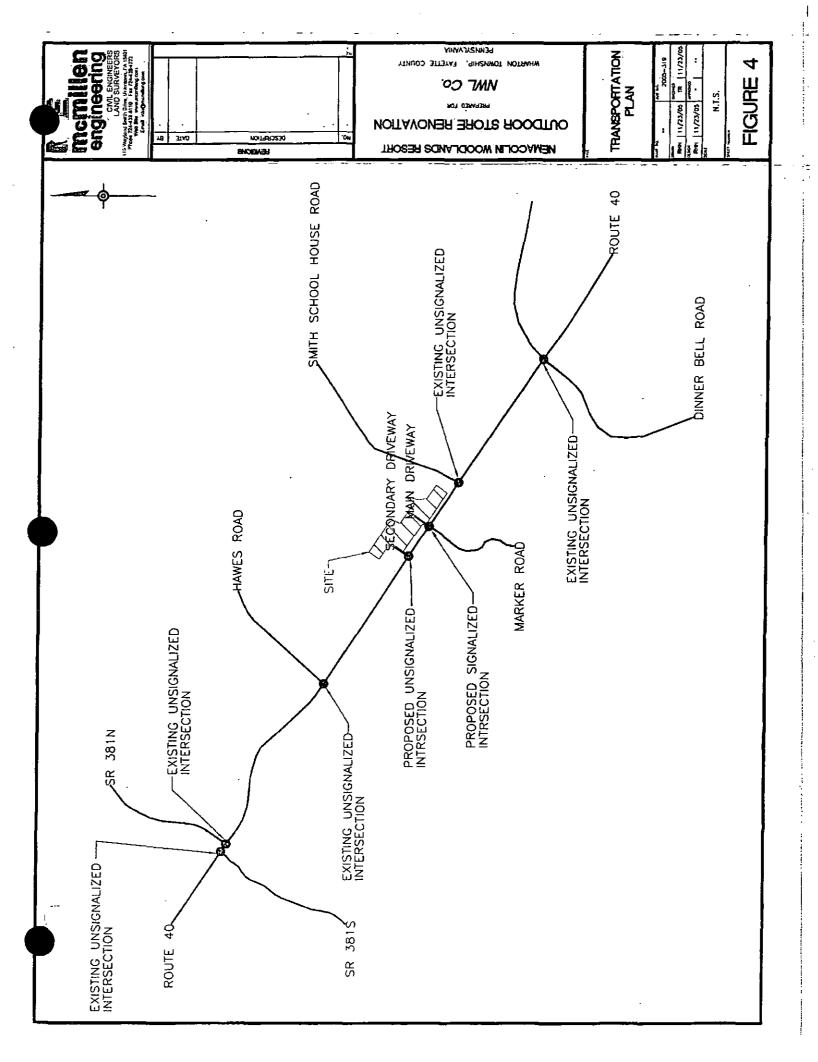
CIVIL ENGINEERS/LAND SURVEYORS

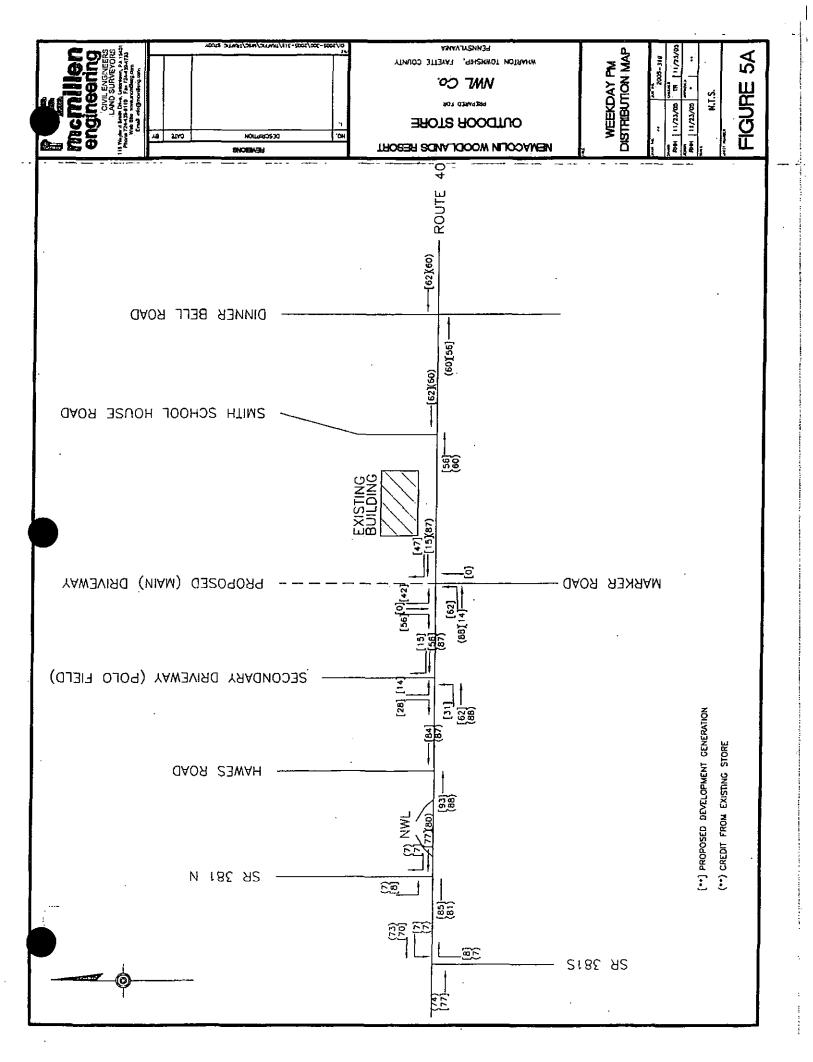
115 Wayland Smith Drive, Uniontown, PA 15401

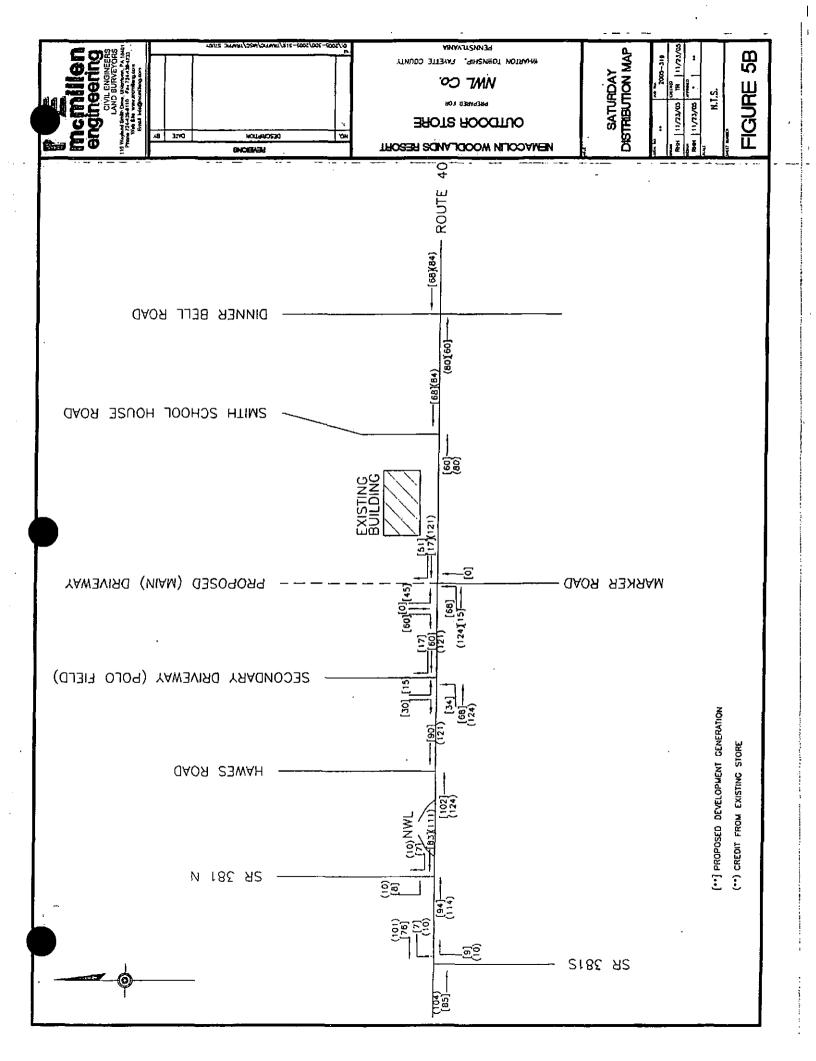
Phone (724) 439—8110

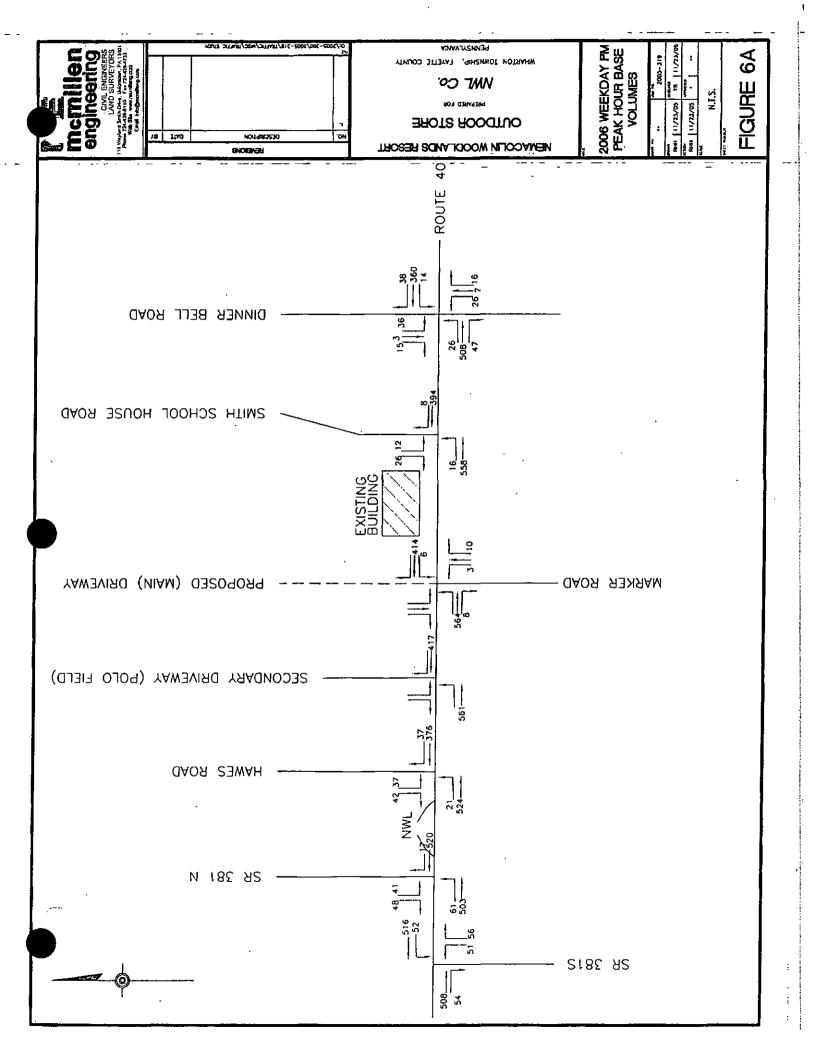


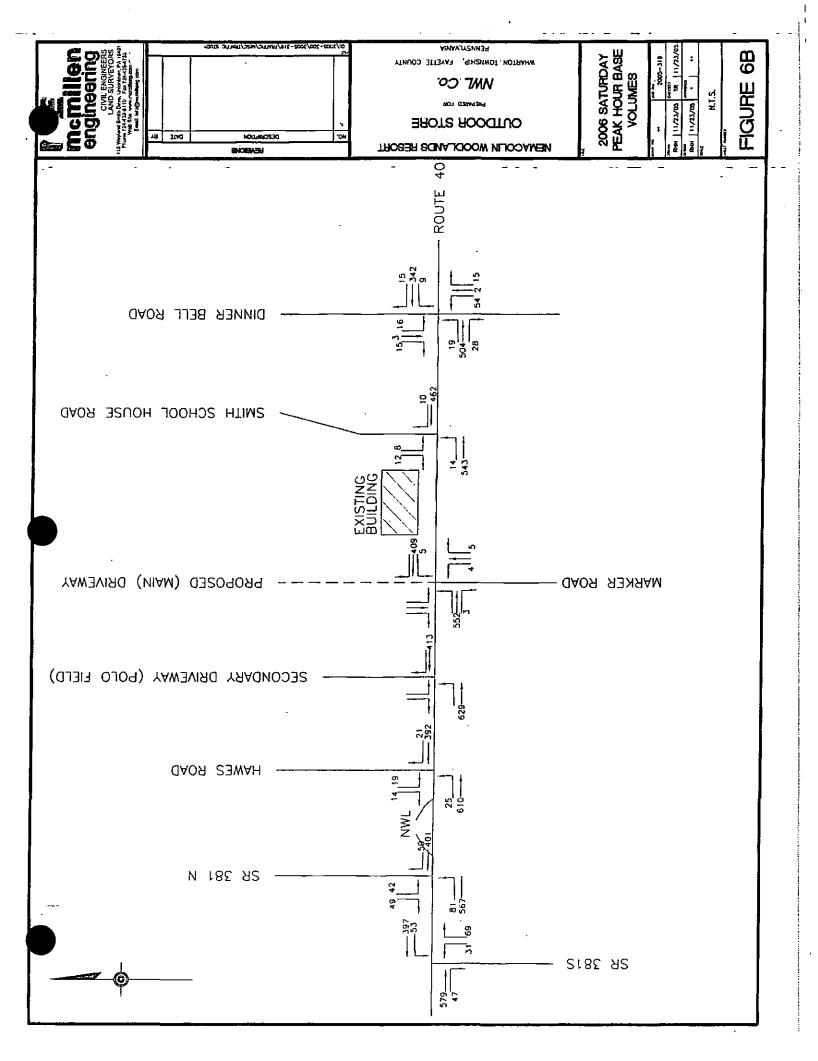


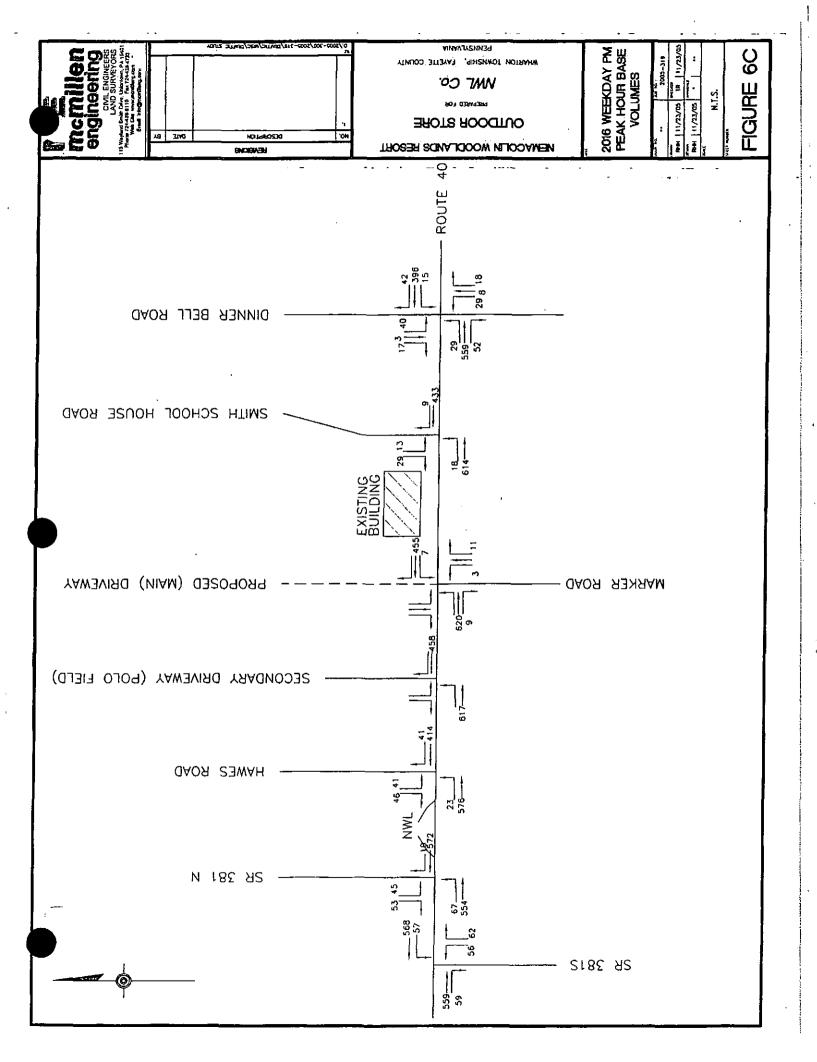


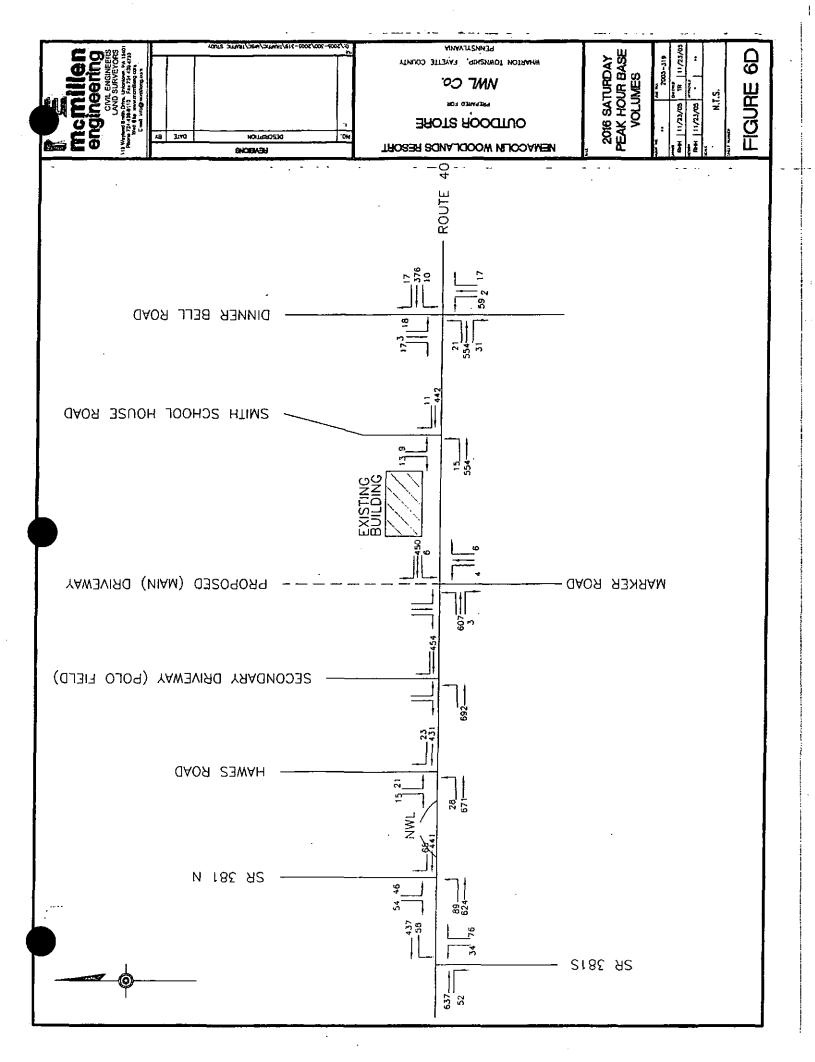


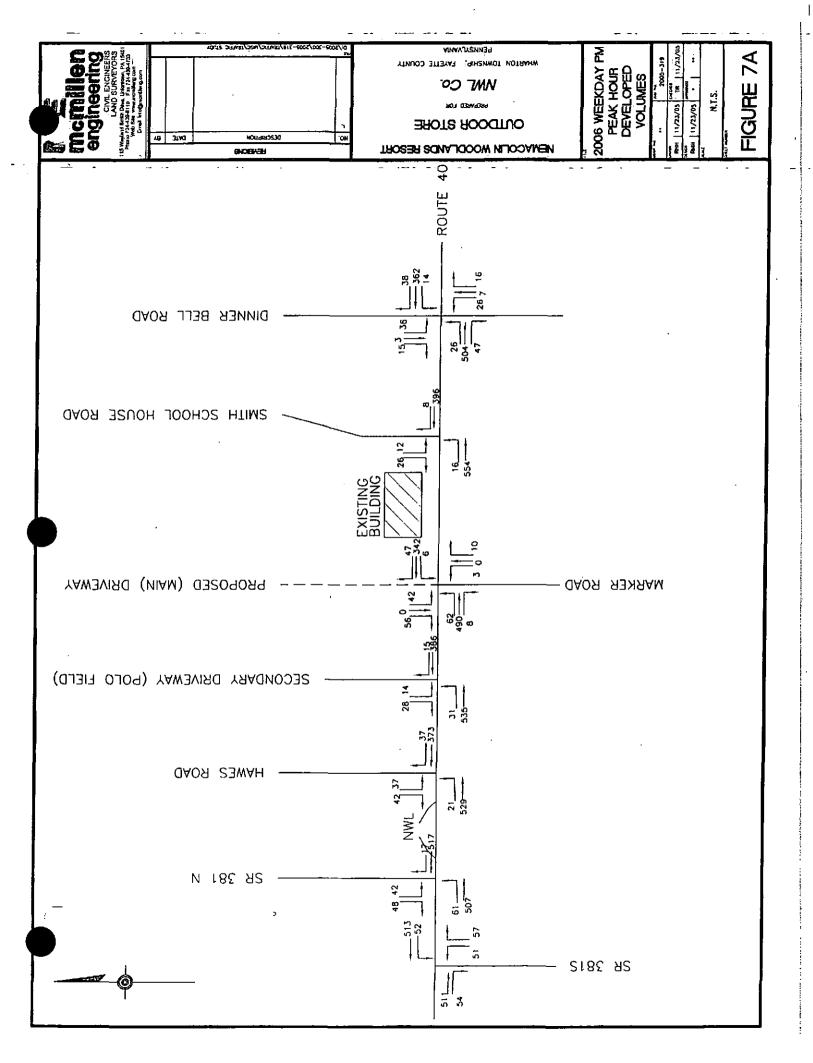


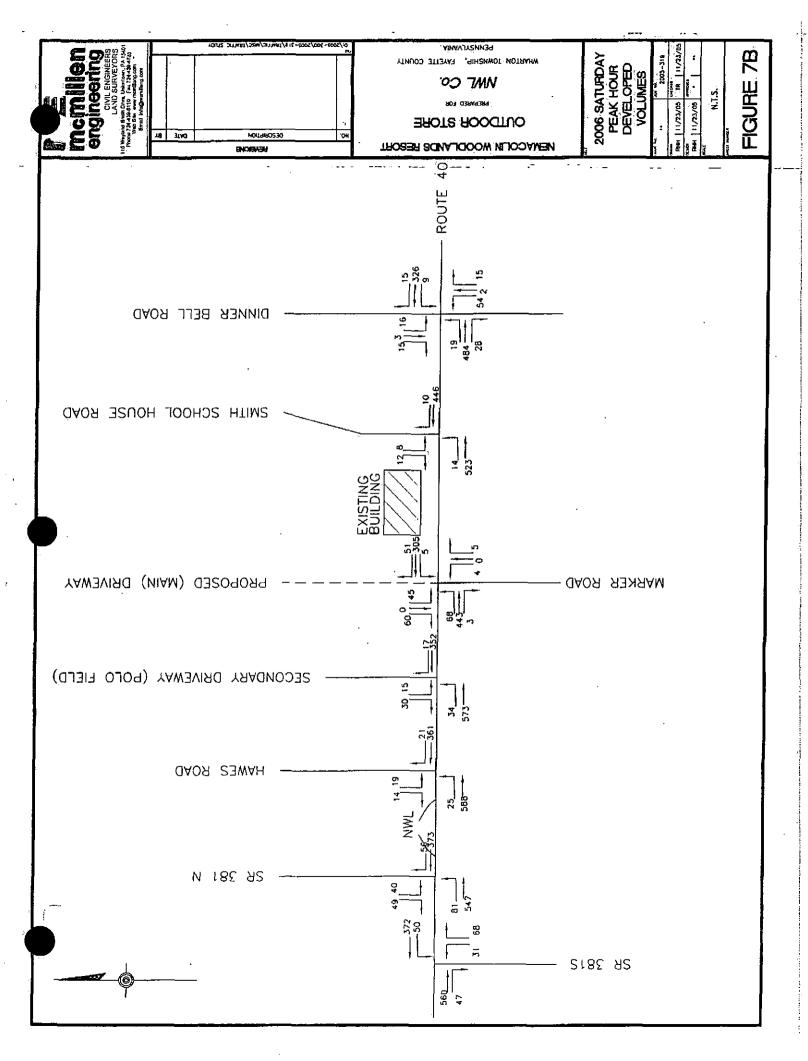


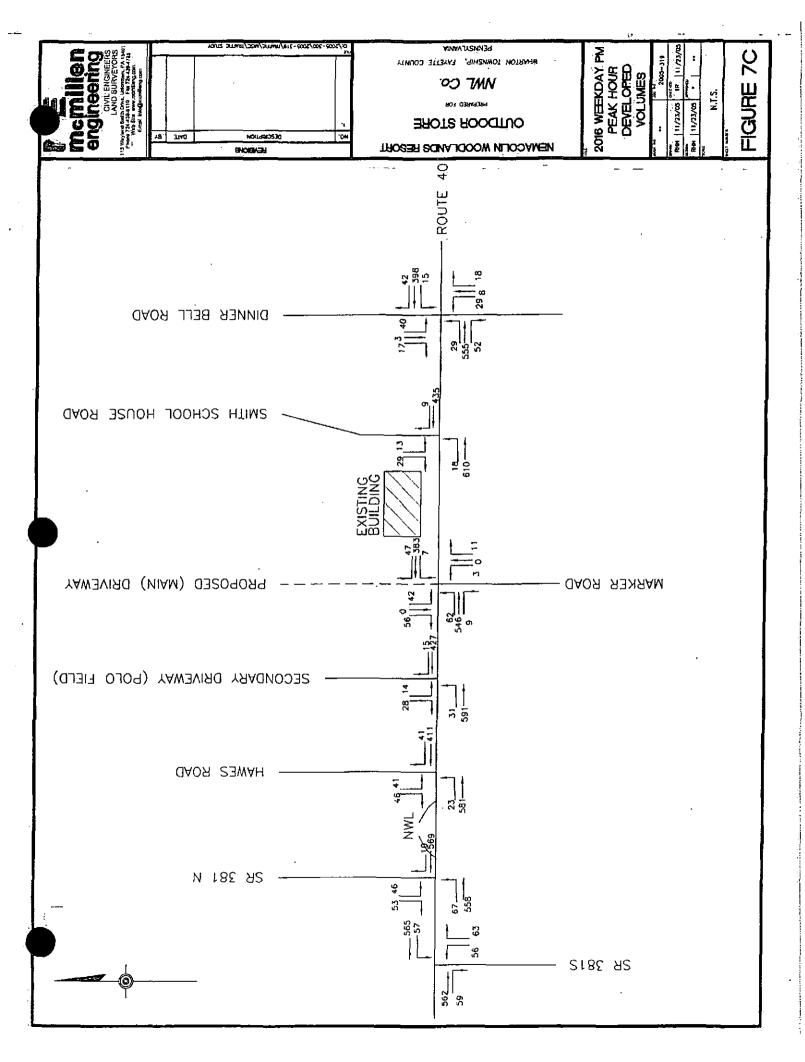


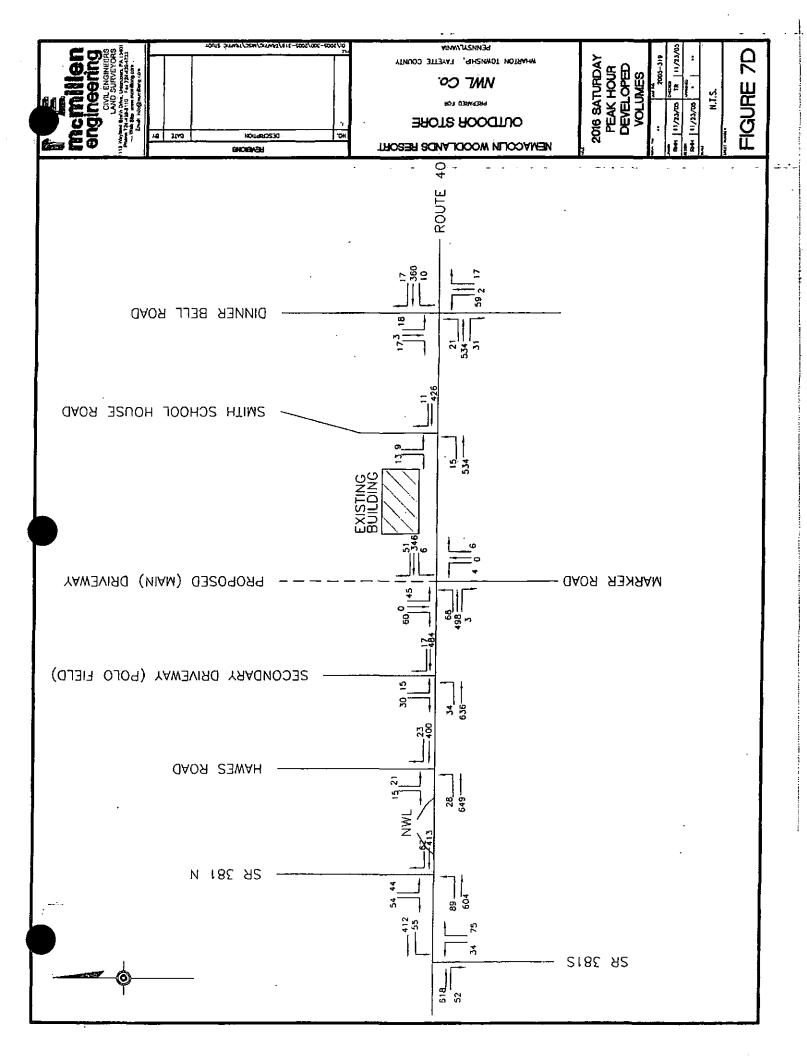


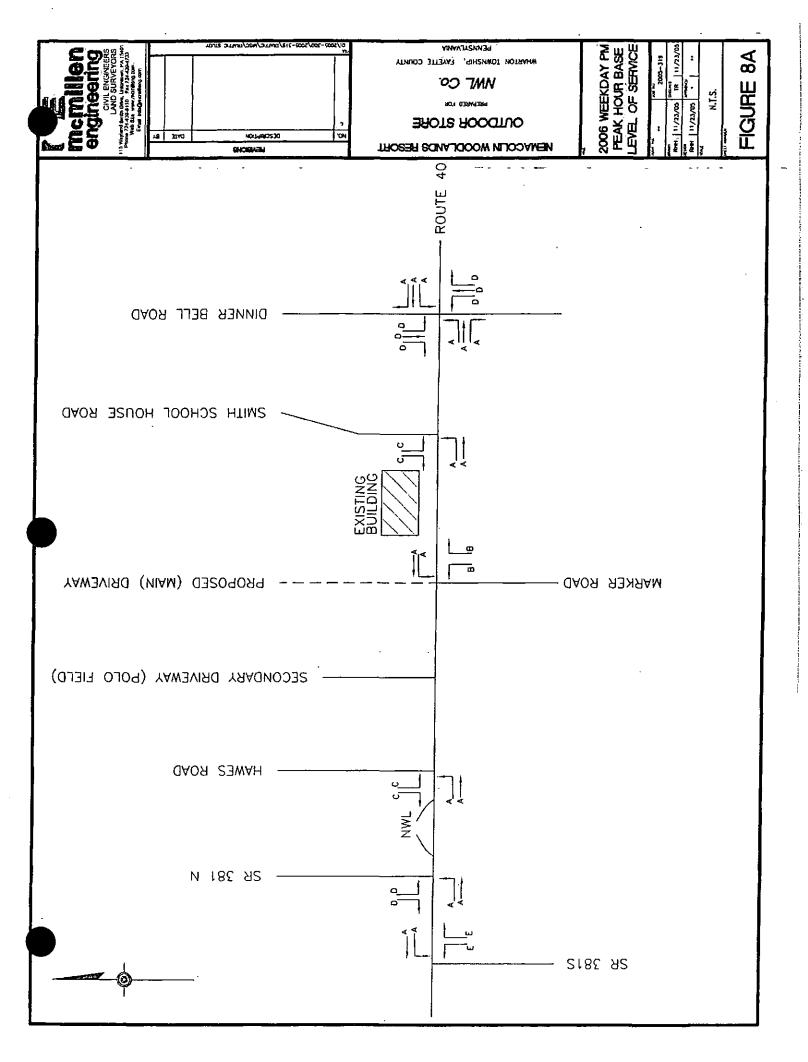


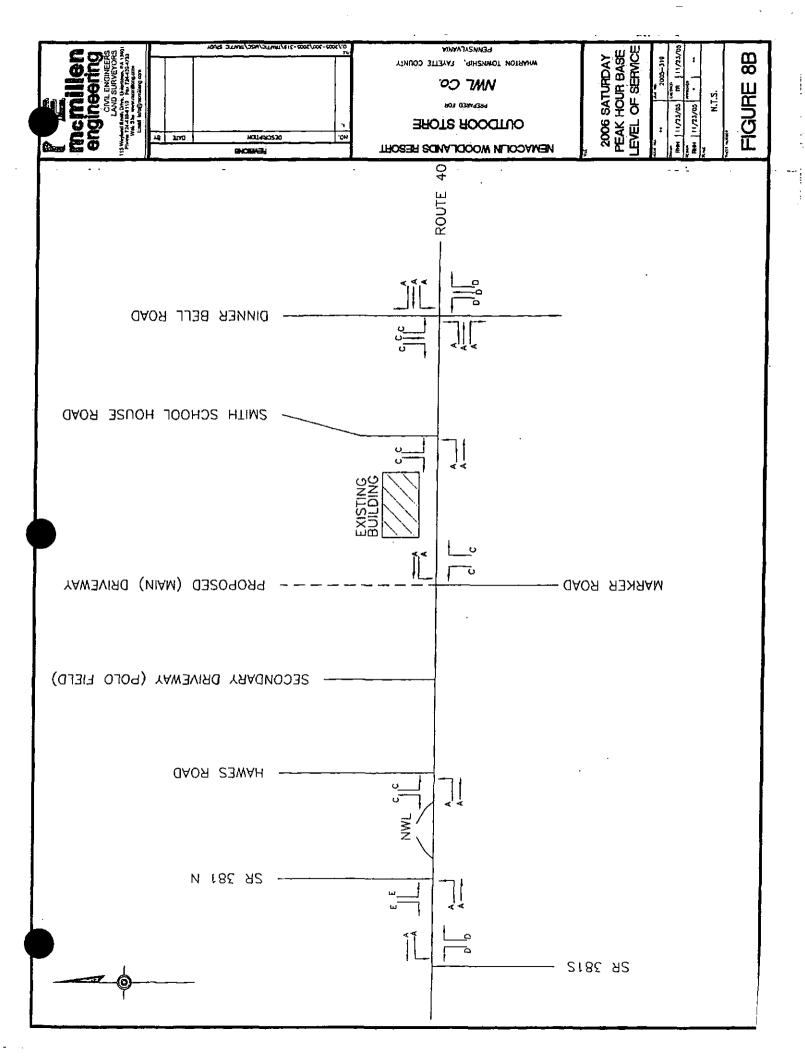


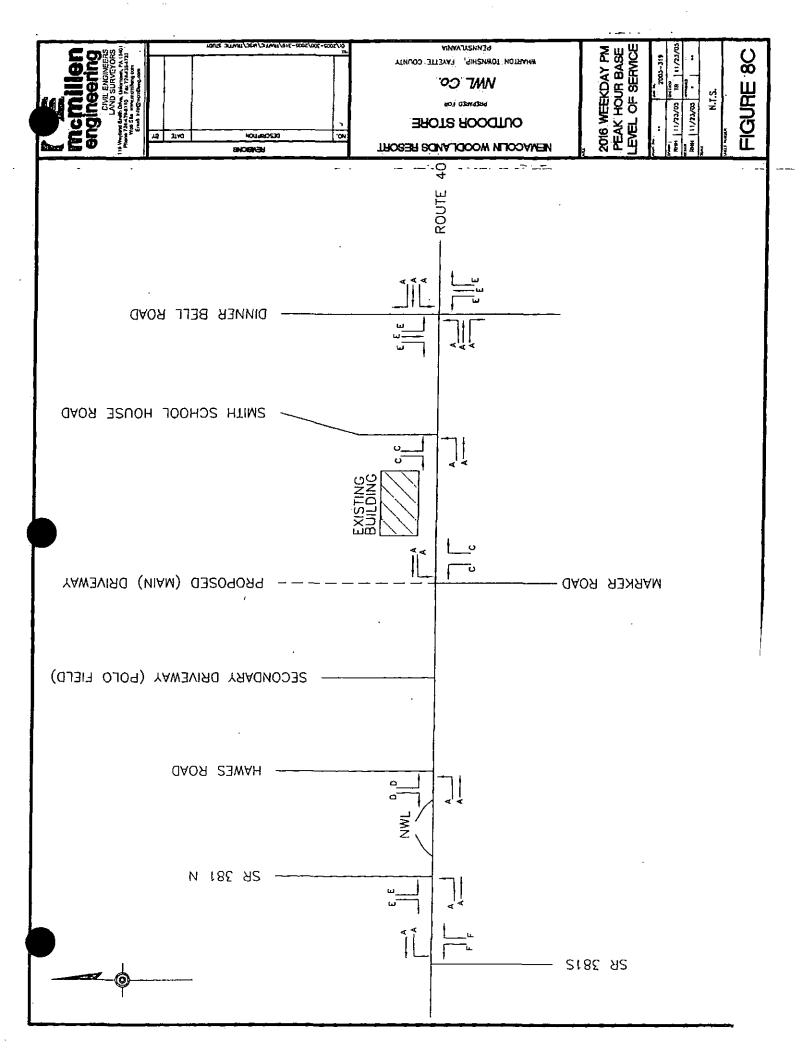


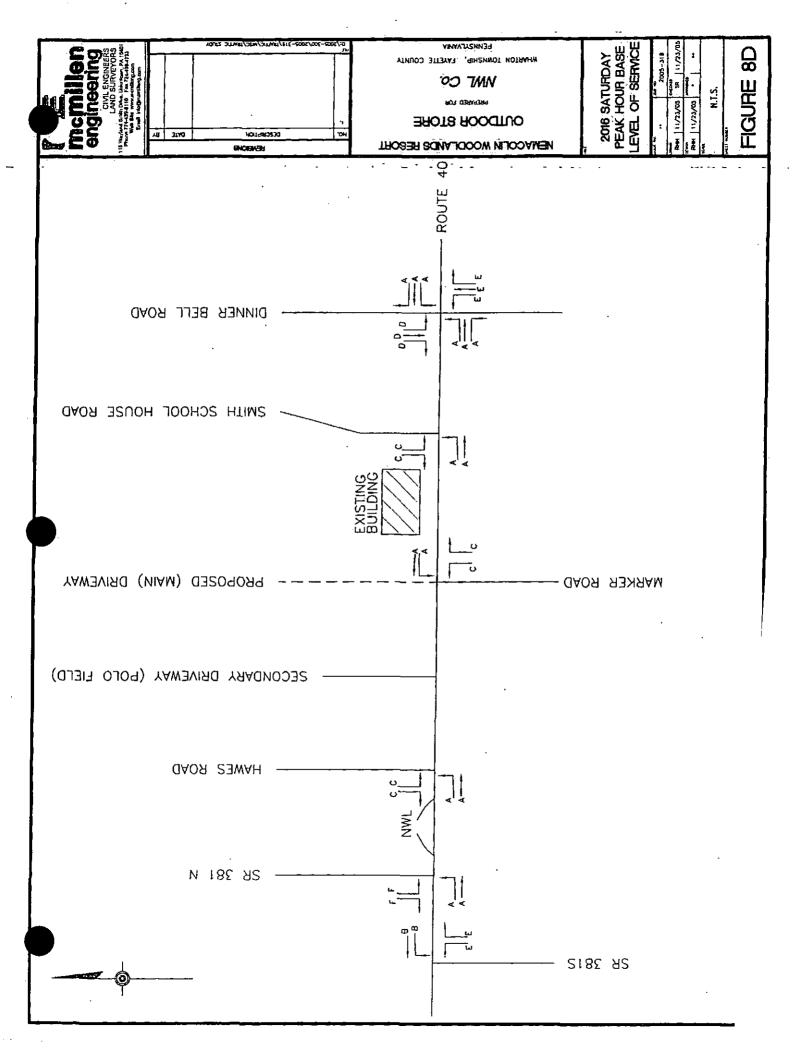


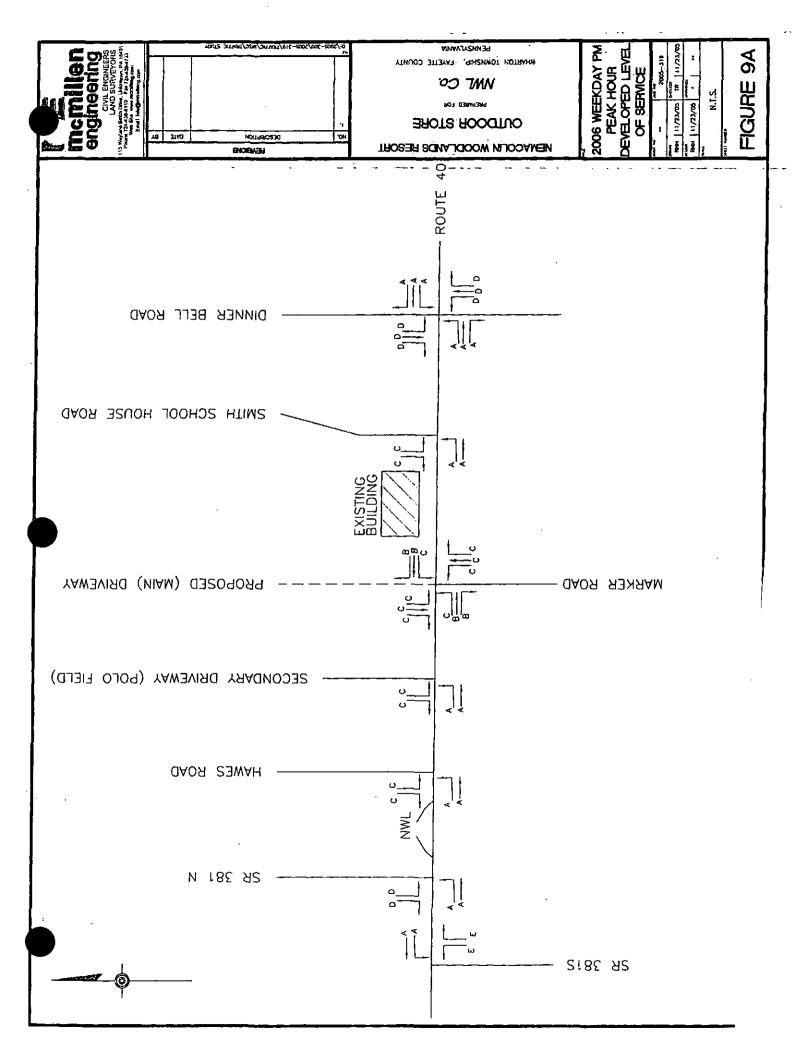


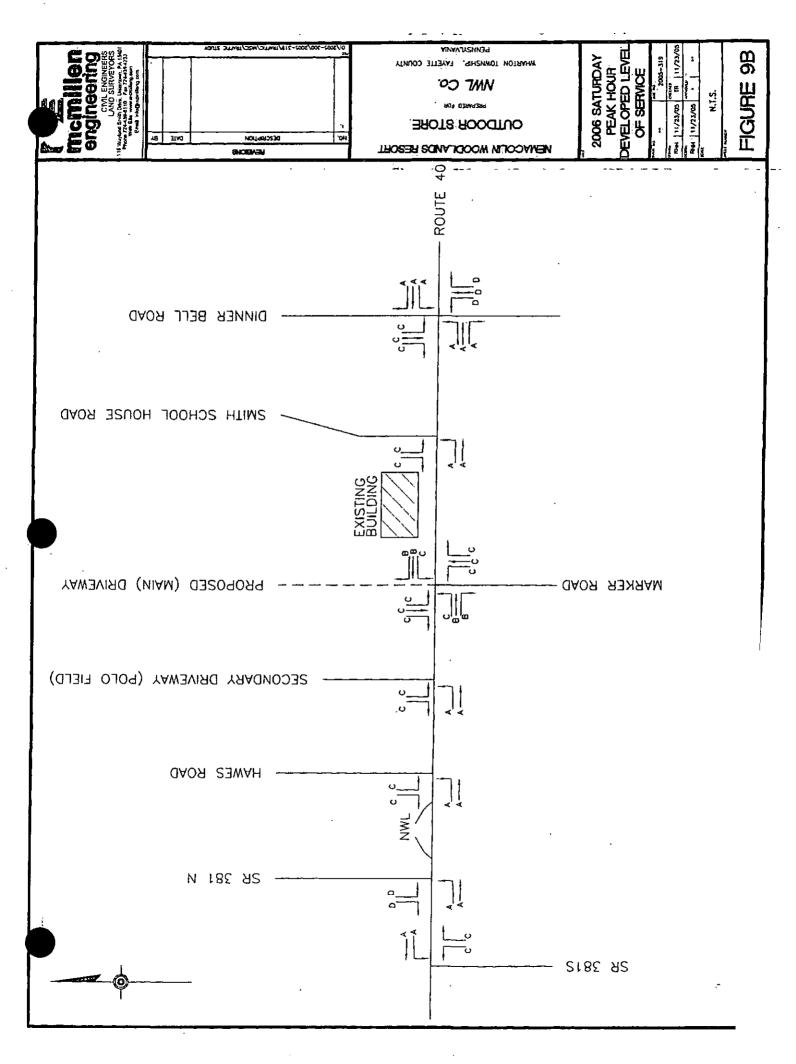


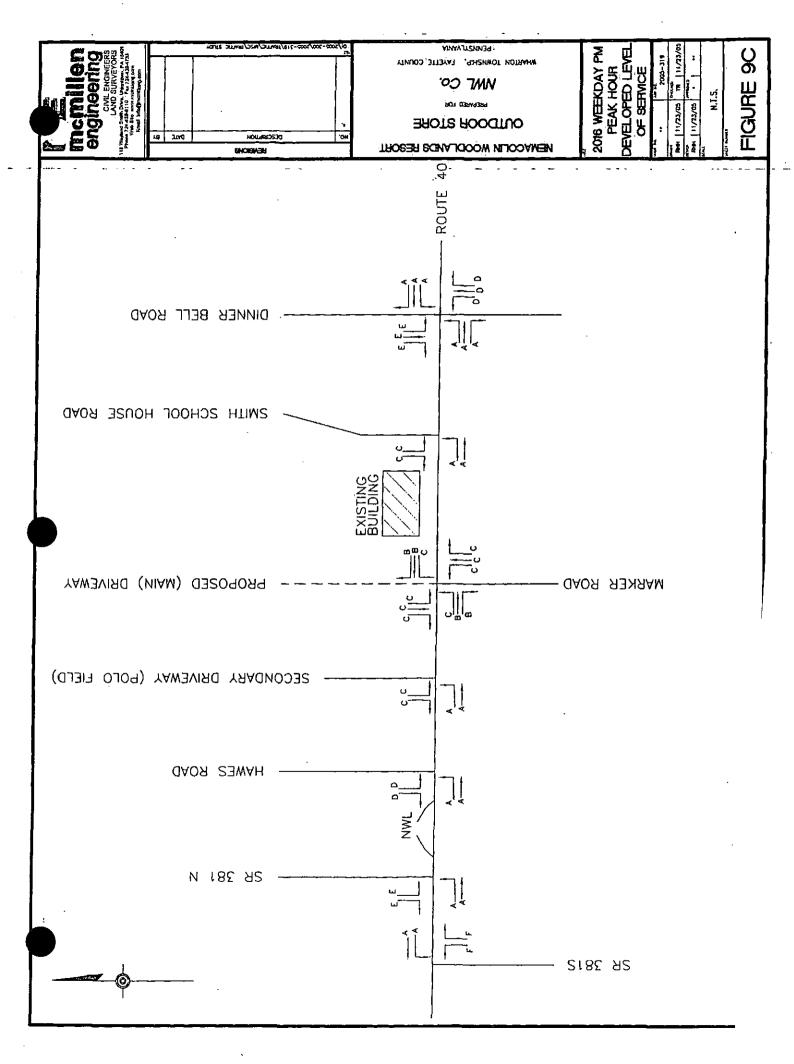


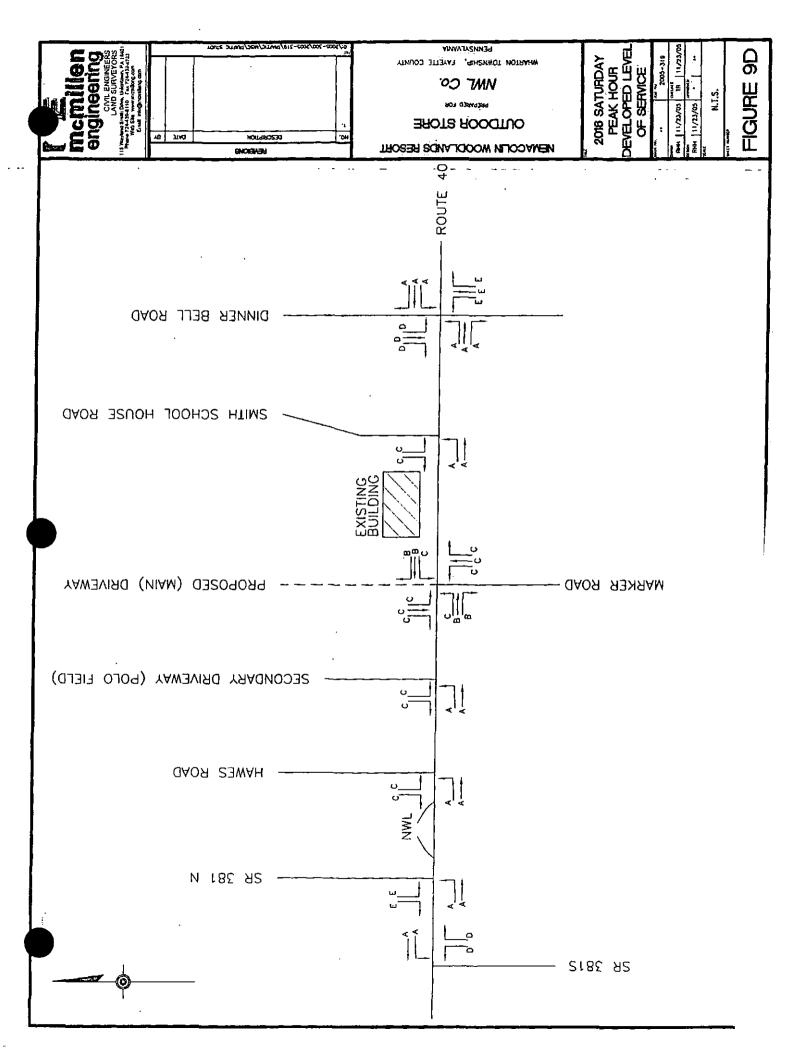












# APPENDIX 1 TRAFFIC COUNT DATA

NWL Outdoor Store Traffic Counts 8/12/05 and 8/13/05

Friday 8/12/05 PM

,					Route	Route 40/SR 381			•	
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## Saturday 8/13/05

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### APPENDIX 2

### CAPACITY ANALYSIS (2006 BASE CONDITIONS)

### HCS2000: Unsignalized Intersections Release 4.1d

### TWO-WAY STOP CONTROL SUMMARY\_\_\_\_

Analyst: TR

.gency/Co.: McMillen Engineering

Date Performed: 10/2/2005

Analysis Time Period: Weekday PM Base Intersection: Route 40/ SR 381 S

Jurisdiction:

Units: U. S. Customary
Analysis Year: 2006

Project ID: Route 40 and SR 381 S East/West Street: Route 40 North/South Street: SR 381 S Intersection Orientation: EW

Study period (hrs): 0.25

Intersection Offentation	. EAA		90	.ucry	berro	a (III-2)	. 0.25	
Ve	hicle Vol	umes and	d Adjus	tme	nts			
Major Street: Approach	Ea.	stbound	-		We	stbound		
Movement	1	2	3		4	5	6	
	I,	Т	R	j	L	T	R	
Volume		508	54		52	516		
Peak-Hour Factor, PHF		0.92	0.75		0.72	0.91		
Hourly Flow Rate, HFR		552	72		72	567		
Percent Heavy Vehicles					3			
Median Type/Storage	Undiv	ided			/			
RT Channelized?				-				
Lanes		1 (			0	1		
Configuration		TF	}		$\Gamma$	Ľ		
"ostream Signal?		No				No		
Minor Street: Approach	No	thbound	l		So	ıthboun	d	
Movement	7	8	9	i	10	11	12	
	L	T	R	ļ	${f L}$	T	R	
Volume	51	0	56				<u></u>	
Peak Hour Factor, PHF	0.71	0.50	1.00					
Hourly Flow Rate, HFR	71	0	56					
Percent Heavy Vehicles	3	3	3					
Percent Grade (%)		7				3		
Flared Approach: Exists	?/Storage		ИО	/			1	
Lanes	0	1 0	}					
Configuration		LTR						
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Movement 1	4 1	7	8	9	1 7		1 12	
Lane Config	LT i	•	LTR	-	i		_ <del>-</del>	

Approach	_Delay, EB	Queue Length WB	n, and Level of Northbound	Service Southbound
Movement	1	4   7	8 9	10 11 12
Lane Config		LT	LTR	l
v (vph)	·····	72	127	
C(m). (vph)		952	232	
v/c		0.08	0.55	
95% queue length		0.24	2.96	
Control Delay		9.1	37.8	
i 'S		A	E	
proach Delay			37.8	
pproach LOS			E	

Phone: E-Mail: Fax:

TWO-WAY STOP CONTROL (TWSC) ANALYSIS

Analyst:

ΤR

Agency/Co.:

McMillen Engineering

Date Performed:

10/2/2005

Analysis Time Period: Weekday PM Base

Intersection:

Route 40/ SR 381 S

Jurisdiction:

Units: U. S. Customary

Analysis Year:

Project ID: Route 40 and SR 381 S

2006

East/West Street:

Route 40

North/South Street:

SR 381 S

Intersection Orientation: EW

Study period (hrs): 0.25

	Vehicle	Volumes	and Ad	justmen	ts		
Major Street Movements		2	3	4	5	6	
	L	T	R	$\mathbf{r}$	T	R	
Jlume		508	54	52	516	<del></del> -	
Peak-Hour Factor, PHF		0.92	0.75	0.72	0.91		
Peak-15 Minute Volume		138	18	18	142		
Hourly Flow Rate, HFR		552	72	72	567		
Percent Heavy Vehicles				3			
Median Type/Storage	Undi	vided		/			
RT Channelized?							
Lanes		1	0	0	1		
Configuration		T	R	L'	T		
Upstream Signal?		No			Мо		
Minor Street Movements	7	8	9.	10	11	1.2	<del></del>
	L	${f T}$	R	L	T	R	
olume	51	0	56	<del></del>			
Peak Hour Factor, PHF	0.71	0.50	1.00				
Peak-15 Minute Volume	18	0	14				
Hourly Flow Rate, HFR	71	0	56				
Percent Heavy Vehicles	3	3	3				
Percent Grade (%)		7			3		
Plared Approach: Exist. RT Channelized?	s?/Storage	3	No	/			/
anes	0	1 (	)				
Configuration	-	LTR	•				

	Pedestrian	Volumes	and Ad	justments	
ovements	13	1.4	15	16	
Flow (ped/hr)	0	0	0	0	

 Lane Width (ft)
 12.0
 12.0
 12.0
 12.0

 Walking Speed (ft/sec)
 4.0
 4.0
 4.0
 4.0

 Percent Blockage
 0
 0
 0
 0

mputation 1-Queue Clearance Time at Upstream Signal

<u>.</u>	Dwar		Upstrea				Dros	Dietanas
	Prog. Flow	Sat Flo			Green Time	Cycle Length	Prog. Speed	Distance to Signal
	vph	vph			sec	sec	mph	feet
	. 6			•	,,,,	***		1000
S2 Left-Tur	rn	•					··	
Through								
S5 Left-Tur	rn					•		
Through						•		
Worksheet 3-	-Data for C	omputin	g Effec	t of De	elay to	Major	Street V	ehicles
					Moveme	nt 2	Moveme	nt 5
Shared ln vo	olume, majo	r th ve	hicles:			_	567	
Shared ln vo	olume, majo	r rt ve	hicles:				0	
Sat flow rat							1800	
Sat flow rat							1800	
Number of ma	jor street	throug.	h lanes	:			1	
				····			** · · · · · · · · · · · · · · · · · ·	
				1713	Calou	lation		
Worksheet 4-	·Critical G	ap and	F.OTTOM-	σδ ττωε	: Calcu			
Critical Gap			F,OTTOM-	up irme	: Calcu			<del></del>
	Calculation 1		7	8	9	10	11	12
Critical Gap	Calculation	on					11 T	12 R
Critical Gap	Calculation 1 L	on 4 L	7 L 7.1	8 T	9 R 6.2	10 L	T	R
Critical Gap 'ovement t(c,base) t(c,hv)	Calculation 1	on 4 L 4.1 1.00	7 L 7.1 1.00	8 T 6.5 1.00	9 R 6.2 1.00	10 L		
Critical Gap 'ovement  t(c,base) t(c,hv) P(hv)	Calculation 1 L	on 4 L	7 L 7.1 1.00	8 T 6.5 1.00	9 R 6.2 1.00	10 L	T 1.00	1.00
Critical Gap 'ovement  t(c,base) t(c,hv) P(hv) t(c,g)	Calculation 1 L	on 4 L 4.1 1.00	7 L 7.1 1.00 3 0.20	8 T 6.5 1.00 3 0.20	9 R 6.2 1.00 3 0.10	10 L 1.00	1.00 0.20	1.00 0.10
Critical Gap Tovement  t(c,base) t(c,hv) P(hv) t(c,g) Grade/100	Calculation 1 L	4 L 4.1 1.00	7 L 7.1 1.00 3 0.20 0.07	8 T 6.5 1.00 3 0.20 0.07	9 R 6.2 1.00 3 0.10 0.07	10 L 1.00 0.20 0.03	T 1.00	1.00
Critical Gap Tovement  t(c,base) t(c,hv) P(hv) t(c,g) Grade/100 t(3,lt)	Calculation 1 L L 1.00	4.1 1.00 3	7 L 7.1 1.00 3 0.20 0.07 0.70	8 T 6.5 1.00 3 0.20 0.07 0.00	9 R 6.2 1.00 3 0.10 0.07 0.00	10 L 1.00 0.20 0.03	1.00 0.20 0.03	1.00 0.10 0.03
Critical Gap Tovement  t(c,base) t(c,hv) P(hv) t(c,g) Grade/100 t(3,lt) t(c,T): 1-s	Calculation 1 L L 1.00	4.1 1.00 3	7 L 7.1 1.00 3 0.20 0.07 0.70 0.00	8 T 6.5 1.00 3 0.20 0.07 0.00 0.00	9 R 6.2 1.00 3 0.10 0.07 0.00 0.00	10 L 1.00 0.20 0.03	1.00 0.20 0.03 0.00	1.00 0.10 0.03 0.00
Critical Gap Tovement  t(c,base) t(c,hv) P(hv) t(c,g) Grade/100 t(3,lt) t(c,T): 1-s	Calculation 1 L L 1.00 tage 0.00 tage 0.00	4.1 1.00 3 0.00 0.00 0.00	7 L 7.1 1.00 3 0.20 0.07 0.70 0.00 1.00	8 T 6.5 1.00 3 0.20 0.07 0.00 0.00 1.00	9 R 6.2 1.00 3 0.10 0.07 0.00 0.00	10 L 1.00 0.20 0.03	1.00 0.20 0.03	1.00 0.10 0.03
Critical Gap Tovement  t(c,base) t(c,hv) P(hv) t(c,g) Grade/100 t(3,lt) t(c,T): 1-s 2-s t(c) 1-s	Calculation 1 L L 1.00	4.1 1.00 3	7 L 7.1 1.00 3 0.20 0.07 0.70 0.00	8 T 6.5 1.00 3 0.20 0.07 0.00 0.00	9 R 6.2 1.00 3 0.10 0.07 0.00 0.00	10 L 1.00 0.20 0.03	1.00 0.20 0.03 0.00	1.00 0.10 0.03 0.00
t(c,base) t(c,hv) P(hv) t(c,g) Grade/100 t(3,lt) t(c,T): 1-s 2-s t(c) 1-s	Calculation 1.00  tage 0.00 tage 0.00 tage tage	4.1 1.00 3 0.00 0.00 0.00 4.1	7 L 7.1 1.00 3 0.20 0.07 0.70 0.00 1.00	8 T 6.5 1.00 3 0.20 0.07 0.00 0.00 1.00	9 R 6.2 1.00 3 0.10 0.07 0.00 0.00	10 L 1.00 0.20 0.03	1.00 0.20 0.03 0.00	1.00 0.10 0.03 0.00
Critical Gap Tovement  t(c,base) t(c,hv) P(hv) t(c,g) Grade/100 t(3,lt) t(c,T): 1-s 2-s t(c) 1-s 2-s	tage 0.00 tage 0.00 tage tage	4.1 1.00 3 0.00 0.00 0.00 4.1	7 L 7.1 1.00 3 0.20 0.07 0.70 0.00 1.00 6.4	8 T 6.5 1.00 3 0.20 0.07 0.00 0.00 1.00	9 R 6.2 1.00 3 0.10 0.07 0.00 0.00 6.2	10 L 1.00 0.20 0.03	1.00 0.20 0.03 0.00	1.00 0.10 0.03 0.00
Critical Gap Tovement  t(c,base) t(c,hv) P(hv) t(c,g) Grade/100 t(3,lt) t(c,T): 1-s 2-s t(c) 1-s 2-s	tage 0.00 tage 0.00 tage tage	0.00 4.1 1.00 3 0.00 0.00 0.00 4.1	7 L 7.1 1.00 3 0.20 0.07 0.70 0.00 1.00 6.4	8 T 6.5 1.00 3 0.20 0.07 0.00 0.00 1.00 6.5	9 R 6.2 1.00 3 0.10 0.07 0.00 0.00 0.00 6.2	10 L 1.00 0.20 0.03 0.00 1.00	1.00 0.20 0.03 0.00 1.00	R 1.00 0.10 0.03 0.00 0.00
Critical Gap Tovement  t(c,base) t(c,hv) P(hv) t(c,g) Grade/100 t(3,lt) t(c,T): 1-s 2-s t(c) 1-s 2-s Follow-Up Time fovement	tage 0.00 tage 0.00 tage tage tage tage	0.00 4.1 1.00 3 0.00 0.00 0.00 4.1	7 L 7.1 1.00 3 0.20 0.07 0.70 0.00 1.00 6.4	8 T 6.5 1.00 3 0.20 0.07 0.00 0.00 1.00 6.5	9 R 6.2 1.00 3 0.10 0.07 0.00 0.00 6.2	10 L 1.00 0.20 0.03 0.00 1.00	1.00 0.20 0.03 0.00 1.00	1.00 0.10 0.03 0.00 0.00
Critical Gap Tovement  t(c,base) t(c,hv) P(hv) t(c,g) Grade/100 t(3,lt) t(c,T): 1-s 2-s t(c) 1-s 2-s Follow-Up Time Movement  c(f,base) c(f,HV)	tage 0.00 tage 0.00 tage tage	0.00 4.1 1.00 3 0.00 0.00 0.00 4.1	7 L 7.1 1.00 3 0.20 0.07 0.70 0.00 1.00 6.4	8 T 6.5 1.00 3 0.20 0.07 0.00 0.00 1.00 6.5	9 R 6.2 1.00 3 0.10 0.07 0.00 0.00 6.2	10 L 1.00 0.20 0.03 0.00 1.00	1.00 0.20 0.03 0.00 1.00	R 1.00 0.10 0.03 0.00 0.00
Critical Gap Tovement  t(c,base) t(c,hv) P(hv) t(c,g) Grade/100 t(3,lt) t(c,T): 1-s 2-s t(c) 1-s 2-s Follow-Up Time fovement	tage 0.00 tage 0.00 tage tage tage tage	0.00 4.1 1.00 3 0.00 0.00 0.00 4.1	7 L 7.1 1.00 3 0.20 0.07 0.70 0.00 1.00 6.4	8 T 6.5 1.00 3 0.20 0.07 0.00 0.00 1.00 6.5	9 R 6.2 1.00 3 0.10 0.07 0.00 0.00 6.2	10 L 1.00 0.20 0.03 0.00 1.00	1.00 0.20 0.03 0.00 1.00	1.00 0.10 0.03 0.00 0.00

Movement 2

Movement 5

V(t) = V(1, prot) = V(t) = V(1, prot)

```
Total Saturation Flow Rate, s (vph)
 Arrival Type
 Effective Green, g (sec)
 Cycle Length, C (sec)
 Rp (from Exhibit 16-11)
  roportion vehicles arriving on green P
 g(q1)
 g (q2)
 g(q)
 Computation 2-Proportion of TWSC Intersection Time blocked
                                                  Movement 2
                                                                       Movement 5
                                               V(t)
                                                       V(1,prot)
                                                                   V(t)
                                                                            V(1,prot)
 aloha
 beta
 Travel time, t(a) (sec)
 Smoothing Factor, F
 Proportion of conflicting flow, f
Max platooned flow, V(c,max)
Min platooned flow, V(c,min)
 Duration of blocked period, t(p)
                                                     0.000
                                                                         0.000
 Proportion time blocked, p
Computation 3-Platoon Event Periods
                                              Result
p(2)
                                              0.000
p(5)
                                              0.000
p (dom)
p(subo)
 onstrained or unconstrained?
Proportion
unblocked
                               (1)
                                                                   (3)
                                                 (2)
for minor
                          Single-stage
                                                  Two-Stage Process
movements, p(x)
                             Process
                                              Stage I
                                                                Stage II
p(1)
p(4)
p(7)
p(8)
p(9)
p(10)
p(11)
p(12)
Computation 4 and 5
Single-Stage Process
Movement
                           1.
                                   4
                                           7
                                                   8
                                                           9
                                                                  10
                                                                          11
                                                                                  12
                           L
                                                   \mathbf{T}
                                                           R
                                   L
                                           L
                                                                                   R
V c,x
                                  624
                                          1299
                                                  1299
                                                          588
s
P_{\mathbf{X}}
V c,u,x
  r,x
  plat,x
Two-Stage Process
                       7
                                          8
                                                           10
                                                                             11
```

V(c,x)		
s 1500	1500	
P(x)		
(c,u,x)		
C(r,x)		
C(plat,x)		-
Worksheet 6-Impedance and Capacity Equ	ations	
Step 1: RT from Minor St.	9	12
Conflicting Flows	588	<del></del>
Potential Capacity .	506	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	506	•
Probability of Queue free St.	0.89	1.00
Step 2: LT from Major St.	4	1
Conflicting Flows	624	
Potential Capacity	952	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	952	
Probability of Queue free St.	0.92	1.00
Maj L-Shared Prob Q free St.	0.89	
tep 3: TH from Minor St.	8	11 .
Conflicting Flows	1299	
Potential Capacity	160.	
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mymnt	0.89	0.89
Movement Capacity	142	
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows	1299	
Potential Capacity	176	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.89
Maj. L, Min T Adj. Imp Factor.		0.92
Cap. Adj. factor due to Impeding mymnt	0.92	0.81
Movement Capacity	163	
Worksheet 7-Computation of the Effect of	of Two-stage Gap Acce	ptance
Step 3: TH from Minor St.	8	11
-		

Part 1 - First Stage
Conflicting Flows
tential Capacity
edestrian Impedance Factor
Cap. Adj. factor due to Impeding mymnt
Movement Capacity
Probability of Queue free St.

71 163	0 142 232	56 506			
7 L	8 T	9 R	10 L	11 T	12 R
ons			_		
	1	.63			
		.63			<del></del>
mvmnt	(	).92		0.92 0.81	
	ĵ	1.00		0.89	•
	1	176			
		 L299		<del></del> <del></del> _	<del></del>
mvmnt.					
mvmnt					
		_			
		7	<u> </u>	10	
		_		1.00	
		142		•	
		142			
mvmnt		0.89		0.89	
		160		1 00	
		1299			
				-	
mvmnt					
	mvmnt  mvmnt  mvmnt  mvmnt  nvmnt	mvmnt  mvmnt  mvmnt  frame ons  7 8 L T  71 0 163 142	1299 160 1.00 0.89 142 1.00 7  mvmnt  1299 176 1.00  mvmnt  0.92 163  163  163  163  7  8  9  L  T  R  71  0  56 163 142 506	1299 160 1.00 0.89 142 1.00  7  mvmnt  1299 176 1.00  mvmnt  0.92 163  163  163  163  163	1299 160 1.00 1.00 1.00 0.89 142 1.00 7 10  7 10  mvmnt  1299 176 1.00 0.89 0.92 0.81 163  163  163  163  163  163

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement			7 L	8 T	9 R	10 L	11 T	. 12 R
C sep	····		163		506			
Volume			71	0	56			
Delay								
Q sep								
Q sep +1								
round (Qsep +1)								
n max					·····			<del></del>
C sh				232				
SUM C sep								
n ·								
<del>-</del>		<u></u>						· · ·
Worksheet 10-Delay	, Queu	e Length,  4 LT	and Le	vel of S	Service 9	10	11	12
Worksheet 10-Delay Movement Lane Config v (vph)		4 LT 72		8 LTR		10	11	12
Worksheet 10-Delay Movement Lane Config v (vph) C(m) (vph)		4 LT 72 952		8 LTR 127 232		10	11	12
Worksheet 10-Delay Movement Lane Config v (vph) C(m) (vph)		4 LT 72 952 0.08		8 LTR 127 232 0.55		10	11	12
Worksheet 10-Delay Movement Lane Config v (vph) C(m) (vph) v/c 95% queue length		4 LT 72 952 0.08 0.24		8 LTR 127 232 0.55 2.96		10	11	12
Worksheet 10-Delay Movement Lane Config v (vph) C(m) (vph) v/c 95% queue length Control Delay		4 LT 72 952 0.08 0.24 9.1		8 LTR 127 232 0.55 2.96 37.8		10	11	12
Worksheet 10-Delay Movement Lane Config  v (vph) C(m) (vph) v/c 95% queue length Control Delay OS		4 LT 72 952 0.08 0.24		8 LTR 127 232 0.55 2.96 37.8 E		10	11	12
Worksheet 10-Delay  Movement Lane Config  v (vph) C(m) (vph) v/c 95% queue length Control Delay os pproach Delay Approach LOS		4 LT 72 952 0.08 0.24 9.1		8 LTR 127 232 0.55 2.96 37.8		10	11	12

### Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5		
p(oj)	1.00	0.92		
v(il), Volume for stream 2 or 5		56 <b>7</b>		
v(i2), Volume for stream 3 or 6		0		
s(il), Saturation flow rate for stream 2 or 5		1,800		
s(i2), Saturation flow rate for stream 3 or 6		18.00		
P*(oj)		0.89		
d(M,LT), Delay for stream 1 or 4		9.1		
N, Number of major street through lanes		1		
d(rank,1) Delay for stream 2 or 5		1.0		

### HCS2000: Unsignalized Intersections Release 4.1d

### TWO-WAY STOP CONTROL SUMMARY

Analyst: TR .

.gency/Co.: McMillen Engineering

.gency/Co.: McMillen E
Date Performed: 10/2/2005

Analysis Time Period: Saturday PeakBase Intersection: Route 40/ SR 381 S

Jurisdiction:

Units: U. S. Customary Analysis Year: 2006

Project ID: Route 40 and SR 381 S East/West Street: Route 40 North/South Street: SR 381 S

Intersection Orientation: EW Study period (hrs): 0.25

Major Street: Approac		icle Volumes and Adjus Eastbound				Westbound				
_	Movement	1	2	3.	-	4	5	6		
		$\mathbf{L}$	${f T}$	R	J	L	T	R		
Volume		<del></del> .	579	4 7		53	397			
Peak-Hour Fact	or, PHF		0.84	0.65		0.74	0.84			
Hourly Flow Rate, HFR			689	72		71	472			
Percent Heavy Vehicles						3	~-			
Median Type/St	orage	Undiv:	ided			/				
RT Channelized	<u>.</u>									
Lanes			1 (	)		0 '	1			
Configuration		TR				LT				
່າstream Signa.	13	•	Ио				No			
Minor Street: Approach	Approach	Northbound'			Southbound			<u> </u>		
	Movement	7	8	9	ŧ	10	11	12		
		L	T	R	İ	L	T	R		
Volume		31	0	69				<del></del>		
Peak Hour Facto	or, PHF	0.86	0.50	0.78						
Hourly Flow Rat	ce, HFR	36	0	88						
Percent Heavy \	/ehicles	3	3	3						
Percent Grade	(웅)		7				3			
Flared Approaci	n: Exists?/	Storage		ИО	/				/	
Lanes		0	1 0							
Configuration			LTR							

Approach	_Delay, EB	WB	enger	, and Lev Northboun		267		Southbound	nd
Movement .	1	4	7	8	9		10	11	12
Lane Config		LT		LTR		i			
v (vph)		71	- <del>-</del>	124					
C(m) (vph)		847		280					
v/c		0.08		0.44					
95% queue length		0.27		2.15					
Control Delay		9.6		27.7					
S		Α		D					
proach Delay				27.7					
Approach LOS				D	•				

Phone: E-Mail:				Fax:					
	TWO-WAY ST	OP CONT	ROL (TWS	C) ANAL	YSIS				
Analyst:	TR								
Agency/Co.:	McMillen Engineering								
Date Performed:	10/2/2005	119411004	±119						
Analysis Time Period:		eakBase							
Intersection:	Route 40/		S						
Jurisdiction:			<del>-</del>						
Units: U. S. Customary	•								
Analysis Year:	2006								
Project ID: Route 40		S							
	Route 40								
	SR 381 S								
Intersection Orientati	on: EW		S	tudy pe	riod (h	rs): '	0.25		
	Vehicle	Volumes	and Ad	iustmen	ts				
Major Street Movements		2	3	4	5	6			
	$oldsymbol{L}$	T	R	L	${f T}$	R			
olume		579	47	53	397				
Peak-Hour Factor, PHF		0.84	0.65	0.74	0.84				
Peak-15 Minute Volume		172	18	18	118				
Hourly Flow Rate, HFR		689	72	71	472				
Percent Heavy Vehicles				3					
Median Type/Storage		vided		1					
RT Channelized?	Ullas	VIGCU		,					
Lanes		1 (	)	0	1				
Configuration		TF		L'					
Jpstream Signal?		Ио			No				
Minor Street Movements	7	8	9	10	11	12			
11.01 001000 1.010	L	$\dot{ ext{T}}$	.R	L	T	R			
Volume	31	0	69						
Peak Hour Factor, PHF	0.86	0.50	0.78						
Peak-15 Minute Volume	9	0.50	22						
lourly Flow Rate, HFR	36	0	88						
Percent Heavy Vehicles	3	3	3						
Percent Grade (%)	5	7	J		3				
	ts?/Storage	,	No	1	~		1		
Tared Approach: DAIS		-		,			,		
anes	0	1 0	<b>)</b>						
Configuration	·	LTR							
							<del></del> -		
		_		linetmor	nt s				
	Pedestrian			-					
ovements	Pedestrian 13	Volumes 14	15	16					

Lane Width (ft) 12.0 12.0 12.0 12.0 Walking Speed (ft/sec) 4.0 4.0 4.0 4.0 Percent Blockage 0 O 0 0 Upstream Signal Data Sat Arrival Green Cycle Prog. Distance Prog. Time Speed to Signal \_ Flow Flow Туре Length feet vph vph sec mph seç <u>52</u> Left-Turn Through S5 Left-Turn Through Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles Movement 2 Movement 5 Shared In volume, major th vehicles: 472 Shared In volume, major rt vehicles: . 0 Sat flow rate, major th vehicles: 1800 Sat flow rate, major rt vehicles: 1800 Number of major street through lanes: 1 Worksheet 4-Critical Gap and Follow-up Time Calculation Critical Gap Calculation. . 7 'ovement 8 9 10 11 12 4 L L  $\mathbf{L}$  $\mathbf{T}$ R L Τ R t(c,base) -4.1 $\overline{7.1}$ 6.5 6.2 1.00 1.00 1.00 t(c,hv) 1.00 1.00 1.00 1.00 1.00 P(hv) 3 3 3 3 0.10 0.20 0.20 t(c,g)0.20 0.20 0.10 0.07 Grade/100 0.07 0.07 0.03 0.03 0.03 0.70 0.00 0.00 t(3,1t) 0.00 0.00 0.00 0.00 0.00 0.00 0.00 t(c,T): 1-stage 0.00 0.00 1.00 2-stage 0.00 0.00 1.00 1.00 0.00 1.00 0.00 1-stage 6.2 t(c) 4.1 6.4 6.5 2-stage Follow-Up Time Calculations 7 9 Movement 8 10 11 12 1 Ţ L L R  $\mathbf{T}$ Τ. Ţ R t(f,base) 4.00 2.20 3.50 3.30 0.90 0.90 t(f,HV) 0.90 0.90 0.90 0.90 0.90 0.90 P(HV) 3 3 3 3 t(f) 2.2 3.5 4.0 3.3

Worksheet 5-Effect of Upstream Signals

mputation 1-Queue Clearance Time at Upstream Signal

Movement 2
'(t) V(1,prot)

Movement 5 V(t) V(1,prot)

V prog

```
Total Saturation Flow Rate, s (vph)
 Arrival Type
 Effective Green, g (sec)
 Cycle Length, C (sec)
 Rp (from Exhibit 16-11)
 Proportion vehicles arriving on green P
 g (q1)
 a(a2)
g (g)
 Computation 2-Proportion of TWSC Intersection Time
                                                         blocked
                                                 Movement 2
                                                                     Movement 5
                                                     V(1,prot) V(t)
                                             V(t)
                                                                         V(1,prot)
alpha
beta
Travel time, t(a) (sec)
Smoothing Factor, F
Proportion of conflicting flow, f
Max platooned flow, V(c, max)
Min platooned flow, V(c,min)
Duration of blocked period, t(p)
Proportion time blocked, p
                                                   0.000
                                                                       0.000
Computation 3-Platoon Event Periods
                                            Result
                                            0.000
\overline{p}(2)
p(5)
                                            0.000
p(dom)
p(subo)
 Constrained or unconstrained?
Proportion
unblocked
                              (1)
                                                (2)
                                                                 (3)
for minor
                         Single-stage
                                                Two-Stage Process
movements, p(x)
                            Process
                                                             Stage II
                                            Stage I
p(1)
p(4)
p(7)
p(8)
p(9)
p(10)
p(11)
p(12)
Computation 4 and 5
Single-Stage Process
Movement
                          1
                                  4
                                          7
                                                 8
                                                         9
                                                                10
                                                                       11
                                                                               12
                          T.
                                  L
                                         L
                                                 Т
                                                         R
                                                                L
                                                                        \mathbf{T}
                                                                                R
V c,x
                                 761
                                        1339
                                                1339
                                                        725
S
Px
V c,u,x
  r,x
  plat,x
Two-Stage Process
                       7
                                        8
                                                         10
                                                                          11
```

. Stage	l Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Sta
V(c,x) s P(x) V(c,u,x)	1500		1500				
C(r,x) C(plat,x)		'				· _ · · · · · ·	<del></del>
Worksheet 6-Impedan	ce and Cap	acity Eq	uations				
Step 1: RT from Min	or St.			9		12	_
Conflicting Flows		<del></del>		725			
Potential Capacity				423			
Pedestrian Impedanc	e Factor			1.00		1.00	
Movement Capacity				423			
Probability of Queu	e free St.			0.79		1.00	
Step 2: LT from Maj	or St.		<del>-</del>	4		1	
Conflicting Flows				761			
Potential Capacity				847			
Pedestrian Impedance	e Factor			1.00		1.00	
Movement Capacity				847			
Probability of Queue				0.92		1.00	
Maj L-Shared Prob Q	free St.			0.89			
tep 3: TH from Mine	or St.	<del>-:</del>	<del></del>	8	~ <del>~</del>	11	
Conflicting Flows				1339			
Potential Capacity				151			
Pedestrian Impedance	e Factor			1.00		1.00	
Cap. Adj. factor due	e to Imped:	ing mymn	5	0.89		0.89	
Movement Capacity				134			
Probability of Queue	e free St.			1.00		1.00	
Step 4: LT from Mino	or St.		<u> </u>	7		1.0	
Conflicting Flows				1339			
Potential Capacity				167			
Pedestrian Impedance				1.00		1.00	
Maj. L, Min T Impeda						0.89	
Maj. L, Min T Adj. I						0.91	
Cap. Adj. factor due	to Impedi	ng mvmnt	•	0.92		0.72	
Movement Capacity				153			

Part 1 - First Stage Conflicting Flows

tential Capacity

edestrian Impedance Factor

Step 3: TH from Minor St.

ap. Adj. factor due to Impeding mymnt Movement Capacity

Probability of Queue free St.

volume (vph) Movement Capacity (vph) Shared Lane Capacity (vph)	36 153	0 134 280	88 423			
Movement	7 L	8 T	9 R	10 L	11 T	12 Ř
Worksheet 8-Shared Lane Calculatio	·					
ć t		1	.53		·	
a y						
Movement Capacity  Results for Two-stage process:			.53 	<del></del>		
Maj. L, Min T Adj. Imp Factor. Cap. Adj. factor due to Impeding m	wmnt		),92		0.91 0.72	
Pedestrian Impedance Factor Maj. L, Min T Impedance factor		1	1.00		1.00 0.89	
Part 3 - Single Stage Conflicting Flows Potential Capacity			1339 167	,		
Potential Capacity Pedestrian Impedance Factor Cap. Adj. factor due to Impeding m Movement Capacity	nvmnt					
Part 2 - Second Stage Jonflicting Flows					_	
Conflicting Flows Potential Capacity Pedestrian Impedance Factor Cap. Adj. factor due to Impeding r Movement Capacity	nvmnt					
Step 4: LT from Minor St.  Part 1 - First Stage		<del></del>	7		10	_
C t Probability of Queue free St:			134 1.00		1.00	
Result for 2 stage process: a Y	······································					
Part 3 - Single Stage Conflicting Flows Potential Capacity Pedestrian Impedance Factor Cap. Adj. factor due to Impeding Movement Capacity	mvmnt		1339 151 1.00 0.89 134		1.00	
Potential Capacity Pedestrian Impedance Factor Cap. Adj. factor due to Impeding Movement Capacity	mvmnt					

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement			7 L		8 I	9 R	10 L	11 T	12
C sep	,	<del></del>	15	3 13	34	423		<del></del>	
Volume			36	0		. 88			
Delay									
Q sep									
Q sep +1					_				
round (Qsep +1)					-				
n max						- <u>-</u> -		<del></del>	
C sh				28	30				
SUM C sep									
n									
					~			<del></del>	·
n C act Worksheet 10-Delay Movement Lane Config	, Queue	Length,	and Le	evel of 8 LTR		rvice	10	11	12
C act Worksheet 10-Delay Movement		4 LT 71		8 LTR			10	11	12
C act Worksheet 10-Delay Movement Lane Config v (vph) C(m) (vph)		4 LT		8 LTR			10	11	12
C act Worksheet 10-Delay Movement Lane Config v (vph) C(m) (vph)		4 LT 71 847 0.08		8 LTR			10	11	12
C act Worksheet 10-Delay Movement Lane Config v (vph) C(m) (vph) v/c 95% queue length		4 LT 71 847 0.08 0.27		8 LTR 124 280 0.44 2.15			10	11	12
C act Worksheet 10-Delay Movement Lane Config v (vph) C(m) (vph) v/c 95% queue length Control Delay		4 LT 71 847 0.08 0.27 9.6		8 LTR 124 280 0.44 2.15 27.7			10	11	12
C act Worksheet 10-Delay Movement Lane Config v (vph) C(m) (vph) v/c 95% queue length Control Delay		4 LT 71 847 0.08 0.27		8 LTR 124 280 0.44 2.15 27.7 D			10	11	12
C act Worksheet 10-Delay Movement Lane Config v (vph) C(m) (vph) v/c 95% queue length Control Delay		4 LT 71 847 0.08 0.27 9.6		8 LTR 124 280 0.44 2.15 27.7			10	11	12

## Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.92
v(il), Volume for stream 2 or 5		472
v(i2), Volume for stream 3 or 6		0
s(il), Saturation flow rate for stream 2 or 5		1800
s(i2), Saturation flow rate for stream 3 or 6		1800
P*(oj)		0.89
d(M,LT), Delay for stream 1 or 4		9.6
N, Number of major street through lanes		1
d(rank,1) Delay for stream 2 or 5		1.1

## HCS2000: Unsignalized Intersections Release 4.1d

### TWO-WAY STOP CONTROL SUMMARY

Analyst: TR

Agency/Co.: McMillen Engineering

Date Performed: 10/2/2005

Analysis Time Period: Weekday PM Base Intersection: Route 40/SR 381 N

Jurisdiction:

Units: U. S. Customary
Analysis Year: 2006

Project ID: Route 40 and SR 381 N East/West Street: Route 40 North/South Street: SR 381 N Intersection Orientation: EW

Flared Approach: Exists?/Storage

Lanes

Configuration

Study period (hrs): 0.25

No

0

1

LTR

Vehic	le Volu	mes and	Adjus	tme	nts		
Major Street: Approach		tbound	,			tbound	
Movement	1	2	3	1	4	5	6
	L	Т	R	ĺ	L	T	R
Volume	61	503		, <del></del>		520	17
Peak-Hour Factor, PHF	0.88	0.92				0.91	0.85
Hourly Flow Rate, HFR	69	546				571	19
Percent Heavy Vehicles	3	<del></del>					
Median Type/Storage RT Channelized?	Undivi	ded			/		
Lanes	0	1				1 0	
Configuration	$_{ m LT}$					TR	
pstream Signal?		No				Ио	
Minor Street: Approach	Nor	thbound			Sou	thbound	
Movement	7	8	9	1	10	11	12
•	L	Т	R	l	L	T	R
Volume					41	0	48
Peak Hour Factor, PHF					0.71	0.50	0.68
Hourly Flow Rate, HFR					57	0	70
Percent Heavy Vehicles					3	3	3
Percent Grade (%)		-5				-7	

	_Delay,	Queue	Le	ngt	h, and Lev	zel of	Ser	vice		
Approach	$\mathbf{E}\mathbf{B}$	WB			Northbour	ıd		Sc	uthboun	d
Movement	1	4		7	8	9	-	10	11	12
Lane Config	$_{ m LT}$		ł				I		LTR	
v (vph)	69								127	
C(m) (vph)	981								274	
v/c	0.07								0.46	
95% queue length	0.23								2.30	
Control Delay	8.9					•			29.0	
)S	Α								D	
Approach Delay									29.0	
Approach LOS									Ð	

Phone: E-Mail: Fax:

TWO-WAY STOP CONTROL (TWSC) ANALYSIS

Analyst:

TR

Agency/Co.:

McMillen Engineering

Date Performed:

10/2/2005

Analysis Time Period: Weekday PM Base

Intersection:

Route 40/SR 381 N

Jurisdiction:

Units: U. S. Customary

Analysis Year:

2006 Project ID: Route 40 and SR 381 N

East/West Street:

Route 40

North/South Street:

SR 381 N

Intersection Orientation: EW

Study period (hrs): 0.25

	Vehicle	Volumes	and	Adjustmen	ts		
Major Street Movements	_ 1	2	3	4	5	6	
	L	T	R	L	Т	R	
.olume	61	503	<u>-</u>		520	17	
Peak-Hour Factor, PHF	0.88	0.92			0.91	0.85	
Peak-15 Minute Volume	17	137			143	5	
Hourly Flow Rate, HFR	69	546			571	19	
Percent Heavy Vehicles	3		- <b>-</b>				
Median Type/Storage RT Channelized?	Undi	lvided ·		/			
Lanes	0	1			1	0	
Configuration	I	T			T	R	
Upstream Signal?		ИО			No		
Minor Street Movements	. 7	8	9	10	11	12	
	$\mathbf{r}$	T	R	L	${f r}$	R	
Volume				41	0	48	
Peak Hour Factor, PHF				0.71	0.50	0.68	
Peak-15 Minute Volume				14	0	18	
Hourly Flow Rate, HFR				57	0	70	
Percent Heavy Vehicles				. 3	3	3	
Percent Grade (%)		<del>-</del> 5			-7		
Flared Approach: Exists RT Channelized?	?/Storag	e		/		No	1
Lanes				0	1 (	)	
Configuration			•		LTR .		

	Pedestrian	Volumes	and Ad	justments_		
Movements	13	14	15	16		
Flow (ped/hr)	0	0	0	0	*****	

Lane Width (ft) 12.0 12.0 12.0 12.0 Walking Speed (ft/sec) 4.0 4.0 4.0 Percent Blockage 0 0 0 0 0

Percent Blockag	<u>-</u>		· · · · · · · · · · · · · · · · · · ·	·	∪. 			
			Upstrea					
	Prog. Flow vph	Sat Flo vph	и Тур	e '		Cycle Length sec	Prog. Speed mph	Distance to Signa feet
S2 Left-Turn								
Through S5 Left-Turn Through								
Worksheet 3-Data	a for C	omputin	g Effec	t of De	elay to	Major S	treet V	ehicles
					Movemen	nt 2	Moveme	nt 5
Shared ln volume	e, majo	r th vel	hicles:		546			
Shared ln volum					0			
Sat flow rate, n					1800			
Sat flow rate, a					1800			
Number of major	street	through	n lanes	:	1			
Critical Gap Cal Movement	l L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
(c,base)	4.1					7.1	6.5	6.2
c(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
?(hv)	3		0 00	0 00	0 10	3 0.20	3 0.20	3
c(c,g) Grade/100			0.20 -0.05	0.20 -0.05	0.10 -0.05			0.10 -0.07
:(3,1t)	0.00		0.05	0.00	0.00	0.70	0.00	0.00
(c,T): 1-stage		0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage 2-stage						6.4	6.5	6.2
Follow-Up Time C	Calculat							
Movement (	l L	4 L	7 L	8 T	9 R .	10 L	11 T	12 R
(f,base)	2.20		-,-			3.50	4.00	3.30
(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
(HV)	3					3	3	3
(f)	2.2					3.5	4.0	3.3
orksheet 5-Effe	ct of U	pstream	Signal	s	<del></del>			
omputation 1-Qu	eue Cle	arance	Time at	Upstr				
					Moveme			ement 5
				Λ (	t) V(	l,prot)	V(t)	V(1,pro

```
Total Saturation Flow Rate, s (vph)
 Arrival Type
 Effective Green, g (sec)
 Cycle Length, C (sec)
 Rp (from Exhibit 16-11)
 Proportion vehicles arriving on green P
 g(q1)
 g (a2)
 g (q)
Computation 2-Proportion of TWSC Intersection Time blocked
                                                Movement 2
                                                                   Movement 5
                                            V(t)
                                                    V(1,prot)
                                                                V(t)
                                                                       V(1, prot)
alpha
beta
Travel time, t(a) (sec)
Smoothing Factor, F
Proportion of conflicting flow, f
Max platooned flow, V(c, max)
Min platooned flow, V(c,min)
Duration of blocked period, t(p)
Proportion time blocked, p
                                                  0.000
                                                                     0.000
Computation 3-Platoon Event Periods
                                           Result
                                           0.000
p(2)
                                           0.000
p(5)
p (dom)
p(subo)
Constrained or unconstrained?
Proportion
unblocked
                             (1)
for minor
                         Single-stage
                                               Two-Stage Process
movements, p(x)
                           Process
                                           Stage I
                                                            Stage II
p(1)
p(4)
p(7)
p(8)
p(9)
p(10)
p(11)
p(12)
Computation 4 and 5
Single-Stage Process
Movement
                          1
                                 4
                                        7
                                                8
                                                              10
                                                                      11
                                                                             12
                         L
                                 L
                                                        R
                                                               L
                                                                       Т
                                                                              R
                        590
ν̄c,x
                                                              1264
                                                                      1264
                                                                             580
s
Pχ
V c,u,x
  r,x
plat,x ب
Two-Stage Process
                      7
                                       8
                                                       10
                                                                         11
```

	Stage1	Stagez	Stager	Stage2	Stager	Stage2	Stage1	Stag
V(c,x)				<u> </u>				
s						1500		1500
P(x)								
V(c,u,x)								
C(r,x) C(plat,x)					· · ·			
Worksheet 6-1	Impedance	and Cap	acity Eq	<sub>[uations</sub>				
Step 1: RT f	rom Minor	St.			9		12	
Conflicting N							580	
Potential Cap							513	
Pedestrian In		Factor			1.00		1.00	
Movement Capa	acity						513	
Probability	of Queue	free St.			1.00		0.86	
Step 2: LT fi	rom Major	St.	<del>*************************************</del>		4		1	
Conflicting F							590	
Potential Cap							981	
Pedestrian In		Factor			1.00		1.00	
Movement Capa							981	
Probability o					1.00		0.93	
Maj L-Shared	Prob Q fi	cee St.					0.90	
Rtep 3: TH fr	om Minor	St.	<u> </u>		. 8		11	
Conflicting F						<u> </u>	1264	
Potential Cap							169	
Pedestrian Im					1.00		1.00	
Cap. Adj. fac		o Impedi	ing mvmn	t	0.90		0.90	
Movement Capa					_		152	
Probability o	of Queue f	ree St.			1.00		1.00	
Step 4: LT fr	om Minor	St.	<del>*************************************</del>		7		10	
Conflicting F			A				1264	
Potential Cap							187	
Pedestrian Im					1.00		1.00	
Maj. L, Min T					0.90			
Maj. L, Min T	-				0.92			
Cap. Adj. fac		o Impedi.	.ng mvmnt	ī.	0.80		0.93	
	city						174	

8

11

Part 1 - First Stage
Conflicting Flows
Stential Capacity
Redestrian Impedance Factor
Cap. Adj. factor due to Impeding mymnt
Movement Capacity
Probability of Queue free St.

Step 3: TH from Minor St.

1.00 0.90 0.92 0.80		1264 187 1.00 0.93 174	
0.90 0.92		187 1.00 0.93	
		187	
7		10	
1.00		152 1.00	
1.00		1264 169 1.00 0.90 152	
	1.00	1.00	1.00 0.90 

## Worksheet 9-Computation of Effect of Flared Minor Street Approaches

							•		
Movement				7	8		10	11	12
				L	T	R	L	T	R
C sep	<u> </u>			<del> </del>			174	152	51:
Volume							57	0	70
Delay .									
Q sep									
Q sep +1									
round (Qsep +1)					٠				
n max									
C sh								274	
SUM C sep									
n									
C act									
Worksheet 10-Delay,	Queue	Length,	and	Level	of	Service		,	
Movement	1	4	7	8		9	10	11	12
Lane Config	LT							LTR	
v (vph)	69							127	
C(m) (vph)	981							274	
v/c	0.07							0.46	
95% queue length	0.23							2.30	
Control Delay	8.9							29.0	
COS	A							D	
Approach Delay								29.0	
Approach LOS								D	

## Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.93	1.00
v(il), Volume for stream 2 or 5	546	
v(i2), Volume for stream 3 or 6	0	
s(il), Saturation flow rate for stream 2 or 5	1800	
s(i2), Saturation flow rate for stream 3 or 6	1800	·
P*(oj)	0.90	
d(M,LT), Delay for stream 1 or 4	8.9	
N, Number of major street through lanes	1	
d(rank,1) Delay for stream 2 or 5	0.9	

## HCS2000: Unsignalized Intersections Release 4.1d

### TWO-WAY STOP CONTROL SUMMARY

Analyst:

TR

Agency/Co.:

McMillen Engineering

Date Performed:

10/2/2005

Analysis Time Period: Saturday Peak Base

Intersection:

Route 40/SR 381 N

Jurisdiction:

Configuration

Units: U. S. Customary Analysis Year:

2006

Project ID: Route 40 and SR 381 N

East/West Street: Route 40

North/South Street:

SR 381 N

Intersection Orientation: EW

Study period (hrs): 0.25

LTR

Vehic	cle Volu	mes and	Adjus	tme	nts				
Major Street: Approach		stbound				stbound			
Movement	1	2	3	1	4	5	6		
	L	T .	R	1	L	T	R		
Volume	81	567				401	59		
Peak-Hour Factor, PHF	0.91	0.84				0.84	0.78		
Hourly Flow Rate, HFR	89	675				477	75		
Percent Heavy Vehicles	3	<del></del>							
Median Type/Storage RT Channelized?	Undivi	.ded		,	/				
Lanes	0	1				1 0	)		
Configuration	LI	t				TF	<b>\</b>		
Upstream Signal?		No				No	,		
Minor Street: Approach	Nor	thbound		Southbound					
Movement	7	8	9	[	10	11	12		
	L	T	R	1	L	T	R		
Volume			<del></del>		42	0	49		
Peak Hour Factor, PHF					0.70	0.50	0.77		
Hourly Flow Rate, HFR					60	0	63		
Percent Heavy Vehicles					3	3	3		
Percent Grade (%)		-5				-7			
Flared Approach: Exists?/S	torage			1			No /		
Lanes					0	1 0			

Approach	EB	WB		-	Northbou	evel of and			outhboun	<u>d</u>
Movement	1	4	1	7	8	· 9	1	10	11	12
Lane Config	LT						1		LTR	
v (vph)	89								, 123	
C(m) (vph)	1013								237	
v/c	0.09								0.52	
95% queue length	0.29								2.72	
Control Delay	8.9								35.5	
os	А								E	
Approach Delay									35.5	
Approach LOS									E	

Phone: E-Mail: Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS\_

Analyst:

TR

Agency/Co.:

McMillen Engineering

Date Performed:

10/2/2005

Analysis Time Period: Saturday Peak Base

Intersection:

Route 40/SR 381 N

Jurisdiction:

Units: U. S. Customary

Analysis Year:

2006

Project ID: Route 40 and SR 381 N

East/West Street:

Route 40

North/South Street:

SR 381 N

Intersection Orientation: EW

Study period (hrs): 0.25

	Vehicle	Volumes	and	Adjustmen	ts		
Major Street Movements	1	2	3	4	5	6	
	L	T	R	T.	${f T}$	R	
√olume	81.	567		<del></del>	401	59	<u> </u>
Peak-Hour Factor, PHF	0.91	0.84			0.84	0.78	
Peak-15 Minute Volume	22	169			119	19	
Hourly Flow Rate, HFR	89	675			477	75	
Percent Heavy Vehicles	3						
Median Type/Storage RT Channelized?	Undi	ivided		/			
Lanes	0	1			1 (	)	
Configuration	I	T			TH	₹	
Upstream Signal?		No			No		
Minor Street Movements	7	8	9	10	11	12	
	L	Ŧ	R	L	T	R	
Volume		······································		42	0	49	
Peak Hour Factor, PHF				0.70	0.50	0.77	
Peak-15 Minute Volume				15	0	16	
Hourly Flow Rate, HFR				60	0	63	
Percent Heavy Vehicles				3	3	3	
Percent Grade (%)		-5			-7		
Flared Approach: Exists RT Channelized?	s?/Storag	e		/		No	/
Lanes'				0	1 0	)	
Configuration					LTR		

Movements	Pedestrian	Volumes 14	•	justments_ 16	
Flow (ped/hr)	0	0	0	0	

Lane Width (ft) 12.0 12.0 12.0 12.0 . Walking Speed (ft/sec) 4.0 4.0 4.0 4.0 Percent Blockage 0 0 0 0

	Prog.	Sat	_		l Data reen (	Cycle	Prog.	Distance
	Flow vph	Flow vph		е т		-	Speed mph	to Signa feet
S2 Left-Turn					····			
Through S5 Left-Turn Through								Name.
Worksheet 3-Date	a for Co	mputing	g Effect	t of De	lay to	Major S	treet V	ehicles
				1	Movemer	nt 2	Moveme	nt 5
Shared ln volume	e, major	th veh	icles:		675			
Shared ln volume	e, major	rt vel	nicles:		0			
Sat flow rate, r	major th	vehic]	es:		1800			
Sat flow rate, r	najor rt	vehicl	.es:		1800			
Number of major	street	through	lanes	;	1			
Critical Gap Cal	lculatio			p Time		<del></del>		
	lculatio 1 L		7 L	8 T	9 R	10 L	11 T	12 · R
Critical Gap Cal Movement	1	n 4	7	8		10		
	1 L	n 4	7	8		1.0 L	T	R
Movement	1 L 4.1	n 4 L	7 L	8 T	R	10 L	T 6.5	R 6.2
fovement t(c,base) t(c,hv)	1 L 4.1 1.00	n 4 L	7 L	8 T	R	10 L 7.1 1.00 3 0.20	6.5 1.00 3 0.20	R 6.2 1.00 3 0.10
t(c,base) t(c,hv) P(hv)	1 L 4.1 1.00 3	n 4 L	7 L	8 T	R 1.00	10 L 7.1 1.00 3 0.20 -0.07	6.5 1.00 3 0.20 -0.07	R 6.2 1.00 3 0.10 -0.07
t(c,base) t(c,hv) P(hv) t(c,g) Grade/100 t(3,lt)	1 L 4.1 1.00 3	1.00	7 L 1.00 0.20 -0.05	8 T 1.00 0.20 -0.05	1.00 0.10 -0.05	10 L 7.1 1.00 3 0.20 -0.07 0.70	6.5 1.00 3 0.20 -0.07 0.00	R 6.2 1.00 3 0.10 -0.07 0.00
Hovement  t(c,base) t(c,hv) P(hv) t(c,g) Grade/100 t(3,lt) t(c,T): 1-stage	1 L 4.1 1.00 3	1.00 0.00	7 L 1.00 0.20 -0.05	8 T 1.00 0.20 -0.05	1.00 0.10 -0.05 0.00	10 L 7.1 1.00 3 0.20 -0.07 0.70 0.00	6.5 1.00 3 0.20 -0.07 0.00 0.00	R 6.2 1.00 3 0.10 -0.07 0.00 0.00
Hovement  t(c,base) t(c,hv) P(hv) t(c,g) Grade/100 t(3,lt) t(c,T): 1-stage 2-stage	1 L 4.1 1.00 3 0.00 0.00 0.00	1.00	7 L 1.00 0.20 -0.05	8 T 1.00 0.20 -0.05	1.00 0.10 -0.05	10 L 7.1 1.00 3 0.20 -0.07 0.70 0.00 1.00	6.5 1.00 3 0.20 -0.07 0.00 0.00	R 6.2 1.00 3 0.10 -0.07 0.00 0.00 0.00
Hovement  t(c,base) t(c,hv) P(hv) t(c,g) Grade/100 t(3,lt) t(c,T): 1-stage	1 L 4.1 1.00 3 0.00 e 0.00 e 0.00 e 4.1	1.00 0.00	7 L 1.00 0.20 -0.05	8 T 1.00 0.20 -0.05	1.00 0.10 -0.05 0.00	10 L 7.1 1.00 3 0.20 -0.07 0.70 0.00	6.5 1.00 3 0.20 -0.07 0.00 0.00	R 6.2 1.00 3 0.10 -0.07 0.00 0.00
Movement  t(c,base) t(c,hv) P(hv) t(c,g) Grade/100 t(3,lt) t(c,T): 1-stage 2-stage 1-stage 2-stage	1 L 4.1 1.00 3 0.00 e 0.00 e 0.00 e 4.1	1.00 0.00 0.00	7 L 1.00 0.20 -0.05 0.00 1.00	8 T 1.00 0.20 -0.05 0.00 1.00	R 1.00 0.10 -0.05 0.00 0.00	10 L 7.1 1.00 3 0.20 -0.07 0.70 0.00 1.00 6.4	6.5 1.00 3 0.20 -0.07 0.00 0.00 1.00 6.5	R 6.2 1.00 3 0.10 -0.07 0.00 0.00 0.00 6.2
Movement  t(c,base) t(c,hv) P(hv) t(c,g) Grade/100 t(3,lt) t(c,T): 1-stage 2-stage 1-stage 2-stage	1 L 4.1 1.00 3 0.00 e 0.00 e 0.00 e 4.1	0.00 0.00 0.00 0.00	7 L 1.00 0.20 -0.05 0.00 1.00	8 T 1.00 0.20 -0.05 0.00 1.00	R 1.00 0.10 -0.05 0.00 0.00	10 L 7.1 1.00 3 0.20 -0.07 0.70 0.00 1.00 6.4	6.5 1.00 3 0.20 -0.07 0.00 0.00 1.00 6.5	R 6.2 1.00 3 0.10 -0.07 0.00 0.00 0.00 6.2
Movement  t(c,base) t(c,hv) P(hv) t(c,g) Grade/100 t(3,lt) t(c,T): 1-stage 2-stage 1-stage 2-stage	1 L 4.1 1.00 3 0.00 e 0.00 e 0.00 e 4.1	1.00 0.00 0.00	7 L 1.00 0.20 -0.05 0.00 1.00	8 T 1.00 0.20 -0.05 0.00 1.00	R 1.00 0.10 -0.05 0.00 0.00	10 L 7.1 1.00 3 0.20 -0.07 0.70 0.00 1.00 6.4	6.5 1.00 3 0.20 -0.07 0.00 0.00 1.00 6.5	R 6.2 1.00 3 0.10 -0.07 0.00 0.00 0.00 6.2
Interpretation of the content of the	1 L 4.1 1.00 3 0.00 e 0.00 e 0.00 e 4.1 E	0.00 0.00 0.00 0.00	7 L 1.00 0.20 -0.05 0.00 1.00	8 T 1.00 0.20 -0.05 0.00 1.00	R 1.00 0.10 -0.05 0.00 0.00	10 L 7.1 1.00 3 0.20 -0.07 0.70 0.00 1.00 6.4	T  6.5 1.00 3 0.20 -0.07 0.00 0.00 1.00 6.5	R 6.2 1.00 3 0.10 -0.07 0.00 0.00 6.2
Interpretation of the second o	1 L 4.1 1.00 3 0.00 e 0.00 e 0.00 e 4.1 E	0.00 0.00 0.00 0.00	7 L 1.00 0.20 -0.05 0.00 1.00	8 T 1.00 0.20 -0.05 0.00 1.00	R 1.00 0.10 -0.05 0.00 0.00	10 L 7.1 1.00 3 0.20 -0.07 0.70 0.00 1.00 6.4	T 6.5 1.00 3 0.20 -0.07 0.00 0.00 1.00 6.5	R 6.2 1.00 3 0.10 -0.07 0.00 0.00 6.2  12 R 3.30 0.90
Movement  t(c,base) t(c,hv) P(hv) t(c,g) Grade/100 t(3,lt) t(c,T): 1-stage 2-stage t(c) 1-stage 2-stage Follow-Up Time Comment  c(f,base) t(f,base) t(f,HV) P(HV)	1 L 4.1 1.00 3 0.00 e 0.00 e 0.00 e 4.1 E Calculat. 1 L	0.00 0.00 0.00 0.00	7 L 1.00 0.20 -0.05 0.00 1.00	8 T 1.00 0.20 -0.05 0.00 1.00	R 1.00 0.10 -0.05 0.00 0.00	10 L 7.1 1.00 3 0.20 -0.07 0.70 0.00 1.00 6.4	T  6.5 1.00 3 0.20 -0.07 0.00 0.00 1.00 6.5	R 6.2 1.00 3 0.10 -0.07 0.00 0.00 6.2  12 R 3.30 0.90 3
Aovement  t(c,base) t(c,hv) P(hv) t(c,g) Grade/100 t(3,lt) t(c,T): 1-stage 2-stage t(c) 1-stage 2-stage Follow-Up Time Officement  t(f,base) t(f,base)	1 L 4.1 1.00 3 0.00 e 0.00 e 0.00 e 4.1 E	0.00 0.00 0.00 0.00	7 L 1.00 0.20 -0.05 0.00 1.00	8 T 1.00 0.20 -0.05 0.00 1.00	R 1.00 0.10 -0.05 0.00 0.00	10 L 7.1 1.00 3 0.20 -0.07 0.70 0.00 1.00 6.4	T 6.5 1.00 3 0.20 -0.07 0.00 0.00 1.00 6.5	R 6.2 1.00 3 0.10 -0.07 0.00 0.00 6.2  12 R 3.30 0.90

Movement 2

V(t)

V(l,prot) V(t)

Movement 5

V(1,prot)

```
Total Saturation Flow Rate, s (vph)
 Arrival Type
 Effective Green, g (sec)
 Cycle Length, C (sec)
 Rp (from Exhibit 16-11)
 Proportion vehicles arriving on green P
 q(q1)
 g (q2)
 q(q)
 Computation 2-Proportion of TWSC Intersection Time
                                                        blocked
                                                Movement 2
                                                                   Movement 5
                                             V(t)
                                                    V(l,prot) V(t)
                                                                        V(1, prot)
 alpha
 beta
 Travel time, t(a) (sec)
 Smoothing Factor, F
 Proportion of conflicting flow, f
Max platooned flow, V(c, max)
Min platooned flow, V(c,min)
 Duration of blocked period, t(p)
                                                  0.000
                                                                     0.000
Proportion time blocked, p
Computation 3-Platoon Event Periods
                                           Result
p(2)
                                           0.000
p(5)
                                           0.000
p (dom)
p(subo)
Constrained or unconstrained?
Proportion
unblocked
                                               (2)
                                                                (3)
                              (1)
for minor
                         Single-stage
                                                Two-Stage Process
movements, p(x)
                           Process
                                           Stage I
                                                            Stage II
p(1)
p(4)
p(7)
p(8)
p(9)
p(10)
p(11)
p(12)
Computation 4 and 5
Single-Stage Process
                          1
                                         7
                                                8
                                                        9
                                                              10
                                                                              12
Movement
                                 4
                                                                      11
                          L
                                 L
                                                        R
                                                               L
                                                                       T
                                                                              R
                         552
                                                              1367
V c,x
                                                                      1367
                                                                             514
s
Рx
V c,u,x
  r,x
င plat,x
Two-Stage Process
                      7
                                       8
                                                       10
                                                                         11
```

	Stager	Stage2	Stagel	Stage2	Stagel	Stage?	Stagel	Stag
V(c,x)								
<b>S</b>						1500		1500
P(x)								
V(c,u,x)								
C(r,x)				-				
C(p.l.at,x)				····				
Worksheet 6-	Empedance	and Cap	acity Eq	uations				
Step 1: RT f	com Minor	St.			9	· <del></del>	12	
Conflicting I						=	514	
Potential Cap							559	
Pedestrian In		Factor			1.00		1.00	-
Movement Capa		_					559	
Probability o	of Queue	free St.			1.00		0.89	
Step 2: LT fr	om Major	St.			4		1	
Conflicting F			······································	<del> </del>	<del></del>		552	
Potential Cap							1013	
Pedestrian Im		Factor			1.00		1.00	
Movement Capa							1013	
Probability o					1.00		0.91	
Maj L-Shared	Prob Q f	ree St.					0.86	
Rtep 3: TH fr	om Minor	St.			8		11	
Conflicting F						***************************************	1367	
Potential Cap		<del> </del>			1 00		147	
Pedestrian Im Cap. Adj. fac			ina mumn	<b></b>	1.00 0.86		1.00 0.86	
Movement Capa		LO IMPEG	riig iliviili	Ļ	0.00		126	
Probability o		free St.			1.00	•	1.00	
Step 4: LT fr	om Minor	St.			7		10	
Conflicting F	lows		·	<del></del>			1367	· · · <del>-</del> · ·
Potential Cap							162	
Pedestrian Im		Factor			1.00		1.00	
Maj. L, Min T			-		0.86			
Maj. L, Min T	Adj. Imp	Factor.	,		0.89			
Cap. Adj. fac	tor due t	o Impedi	.ng mvmnt	;	0.79		0.91	
	city						148	

11

Part 1 - First Stage
Conflicting Flows
Stential Capacity
Redestrian Impedance Factor
Cap. Adj. factor due to Impeding mymnt
Movement Capacity
Probability of Queue free St.

Step 3: TH from Minor St.

Part 2 - Second Stage Conflicting Flows						
Potential Capacity						
Pedestrian Impedance Factor						
Cap. Adj. factor due to Impeding mymnt	t					
Movement Capacity						
Part 3 - Single Stage					1267	
Conflicting Flows Potential Capacity					1367 147	
Potential Capacity Pedestrian Impedance Factor			1.00		147	
Cap. Adj. factor due to Impeding mymnt	Γ.		0.86		0.86	
Movement Capacity	-		~		126	
Result for 2 stage process:						
а У						
Ct					126	
Probability of Queue free St.	_		1.00		1.00	
Step 4: LT from Minor St.			7		10	
Part 1 - First Stage				<del></del> !		
Conflicting Flows Potential Capacity						
Potential Capacity Pedestrian Impedance Factor						
Cap. Adj. factor due to Impeding mvmnt	<u>.</u>					
Movement Capacity						
Part 2 - Second Stage						
Conflicting Flows						
Potential Capacity Pedestrian Impedance Factor					•	
Cap. Adj. factor due to Impeding mymnt						
Movement Capacity						
Part 3 - Single Stage				<del>_,</del> ,	1007	
Conflicting Flows Potential Capacity					1367 162	
Pedestrian Impedance Factor			1.00	•	1.00	
Maj. L, Min T Impedance factor			0.86		<b>.</b>	
Maj. L, Min T Adj. Imp Factor.			0.89			
Cap. Adj. factor due to Impeding mvmnt			0.79		0.91	
Movement Capacity					148	
Results for Two-stage process: a						_
y						
C t	_		_	_	148	
Worksheet 8-Shared Lane Calculations						
	7	8	9	10	11	1
	L	Т	R	L	T	
				60	0	6
Volume (vph) Movement Capacity (vph)				148	126	5

## Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement

Approach Delay Approach LOS

12

				L	T	R	L	Т	R
C sep							148	126	55!
Volume							60	0	63
Delay									
Q sep									
Q sep +1									
round (Qsep +1)									
n max.									
C sh								237	
SUM C sep									
n .									
C act					_				
Worksheet 10-Delay,	Queue	Length,	and	Level	of S	Service			
Movement	1	4	7	8		9	10	11	12
Lane Config	LT							LTR	
v (vph)	89							123	
C(m) (vph)	1013							237	
v/c	0.09							0.52	
95% queue length	0.29							2.72	
Control Delay	8.9							35.5	
7.OS	ĮΑ							E	
Approach Delay	-							35.5	
3 + A.Z.									

## Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.91	1.00
v(il), Volume for stream 2 or 5	675	
v(i2), Volume for stream 3 or 6	0	•
s(il), Saturation flow rate for stream 2 or 5	1800	
s(i2), Saturation flow rate for stream 3 or 6	1800	
P*(oj)	0.86	
d(M, LT), Delay for stream 1 or 4	8.9	
N, Number of major street through lanes	1	
d(rank,1) Delay for stream 2 or 5	1.3	

### HCS2000: Unsignalized Intersections Release 4.1d

#### TWO-WAY STOP CONTROL SUMMARY

Analyst:

TR

Agency/Co.:

McMillen Engineering

Date Performed:

10/2/2005

Analysis Time Period: Weekday PM Base

Intersection:

Route 40/ Hawes Road

Jurisdiction:

Units: U. S. Customary Analysis Year:

2006

Project ID: Route 40 and Hawes Road

East/West Street: Route 40

North/South Street: Hawes Road

Intersection Orientation: EW

Study period (hrs): 0.25

			d Adju	15 CILIE				
Approach		tbound				stbound		
Movement	1	2	3	ļ	4	5	6	
•	L	T	R	I	L	T	R	
	21	524	_			376	37	
or, PHF	0.66	0.92				0.91	0.66	
te, HFR	31	569				413	56	
Vehicles	3					<del></del>		
	Undivi	ded			/			
	-			`				
	0	1				1	0	
	ኒጥ	-					Ŕ	
1?		No						
						_		
Approach	Nor	thbound	i		So	uthboun	d .	
Movement	7	8	9	1	10	11	12	
	L	T	R	- 1	L	T	R	
					37	0	42	
or, PHF					0.62	0.50	0.66	
					59	0	63	
-					3	3	3	
		<del>-</del> 5	•			-10		
• •	Storage			/			No	1
	,-			•	0	1 (	)	-
					-	LTR	-	
t :	Movement  or, PHF te, HFR Vehicles orage ?  Approach Movement  or, PHF te, HFR Vehicles (%)	Movement 1 L  21 0r, PHF 0.66 te, HFR 31 Vehicles 3 0rage Undivi ?  0 LT Approach Nor Movement 7 L  or, PHF te, HFR Vehicles	Movement 1 2 L T  21 524  or, PHF 0.66 0.92  te, HFR 31 569  Vehicles 3  orage Undivided  ?  0 1 LT  l? No  Approach Northbound Movement 7 8 L T  or, PHF  ce, HFR Vehicles (%) -5	Movement 1 2 3 L T R  21 524  or, PHF 0.66 0.92 te, HFR 31 569 Vehicles 3 orage Undivided  O 1 LT  No  Approach Northbound Movement 7 8 9 L T R  or, PHF te, HFR Vehicles (%) -5	Movement 1 2 3   L T R    21 524  or, PHF 0.66 0.92  te, HFR 31 569  Vehicles 3  orage Undivided  ?  0 1  LT  1? No  Approach Northbound  Movement 7 8 9    L T R    or, PHF  te, HFR  Vehicles (%) -5	Movement 1 2 3   4   L T R   L   L   T R   L   L   L   L   L   L   L   L   L	Movement 1 2 3   4 5   L T R   L T    21 524 376 0.91 0.91 0.91 0.91 13	Movement 1 2 3   4 5 6

			Le	ngt	n, and Le		Ser	_		<del>-, -</del>
Approach	EB	WB			Northbou	na		S	outhboun	a
Movement	.1	4	1	7	8	9	1	10	11	12
Lane Config	LT						ł		LTR	
v (vph)	31	_				· · · · ·			122	
C(m) (voh)	1087								347	
v/c	0.03								0.35	
95% queue length	0.09								1.54	
Control Delay	8.4								20.9	
os	Α								С	
Approach Delay									20.9	
Approach LOS									С	

Phone: E-Mail: Fax:

TWO-WAY STOP CONTROL (TWSC) ANALYSIS\_\_\_\_

Analyst:

TR

Agency/Co.:

McMillen Engineering

Date Performed:

10/2/2005

Analysis Time Period: Weekday PM Base

Intersection:

Route 40/ Hawes Road

Jurisdiction:

Units: U. S. Customary

Analysis Year:

2006

Project ID: Route 40 and Hawes Road

East/West Street: Route 40

North/South Street:

Hawes Road

Intersection Orientation: EW

Study period (hrs): 0.25

	Vehicle	Volumes	and	Adjustmen	ts		
Major Street Movements	_ 1	2	3	Ţ	5	6	
_	, F	T	R	${f L}$	T	R	
Volume	21	524			376	37	
	0.66	0.92			0.91	0.66	
Peak-Hour Factor, PHF					_		
Peak-15 Minute Volume	8	142			103	14	
Hourly Flow Rate, HFR	31	569			413	56	
Percent Heavy Vehicles	3			,			
Median Type/Storage	Undi	vided		1			
RT Channelized?	_	_				-	
Lanes	0	1			-	)	
Configuration	1	'L			T	₹	
Upstream Signal?		No		•	No		
Minor Street Movements	7	8	9	10	11	12	
	L	T	R	${f L}$	${f T}$	R	
Volume				37	0	42	
Peak Hour Factor, PHF				0.62	0.50	0.66	
Peak-15 Minute Volume				15	Ō	16	
Hourly Flow Rate, HFR				59	Ō	63	
Percent Heavy Vehicles				3	3	3	
Percent Grade (%)		-5		•	-10	J	
Flared Approach: Exist:	s?/Storag	•		/	20	Мо	/
RT Channelized?				_			
Lanes				0	1 0	)	
Configuration					LTR .		
·				<del>.</del>		·	

Movements	Pedestrian		-	justments 16
Flow (ped/nr)	0	0	0	0

Lane Width (ft) 12.0 12.0 12.0 12.0 Walking Speed (ft/sec) 4.0 4.0 4.0 Percent Blockage 0 0 0 0

Percent Bl	ockage		0	,	0	0	0	•	
			ט	pstrea	m Sign	al Data			
	E	rog. low ph	Sat Flow Vph	Arri Typ	e '	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signa feet
S2 Left-T Throug S5 Left-T Throug	h urn								
Worksheet	3-Data f	or Cor	nputing	Effec	t of D	elay to	Major S	treet V	ehicles
	,					Moveme	nt 2	Moveme	nt 5
Shared in Shared in Sat flow ra Sat flow ra Number of i	volume, ate, maj ate, maj	major or th or rt	rt vehicle vehicle	icles: es: es:	:	569 0 1800 1800			
Worksheet				ollow-u	ıp Time	e Calcu	lation		
Critical Ga Movement	_	lation 1 L	4 L	<b>7</b> L .	8 T	9 R	10 L	11 T	12 R
t(c,base) t(c,hv) P(hv)		.1	1.00	1.00	1.00	1.00	7.1. 1.00 3	6.5 1.00 3	6.2 1.00 3
t(c,g) Grade/100 t(3,lt)		.00	2 00	0.20.	0.20		0.70	0.00	0.10 -0.10 0.00
2- t(c) 1-	-stage 0: -stage 0 -stage 4 -stage	.00	0.00 0.00	0.00	0.00	0.00	0.00 1.00 6.4	0.00 1.00 6.5	0.00 0.00 6.2
Follow-Up T									
Movement		<u>l</u>	4 L	7 L	8 T	9 R ·	10 L	11 T	12 R
t(f,base) t(f,HV) P(HV)		. <b>20</b> . 90	0.90	0.90	0.90	0.90	3.50 0.90 3	4.00 0.90 3	3.30 0.90 3
t(f)		. 2					3.5	4.0	3.3
Worksheet 5	-Effect	of Up	stream	Signal	s				
noitation	1-Queue	clea:	rance T	ime at	Upstr V(	Moveme		Mov V(t)	ement 5 V(l,prot

```
Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
 Proportion vehicles arriving on green P
g(a1)
g (q2)
g(q)
Computation 2-Proportion of TWSC Intersection Time blocked
                                                                   Movement 5
                                               Movement 2
                                            V(t)
                                                    V(1,prot) V(t)
                                                                       V(1,prot)
alpha
beta
Travel time, t(a) (sec)
Smoothing Factor, F
Proportion of conflicting flow, f
Max platooned flow, V(c,max)
Min platooned flow, V(c,min)
Duration of blocked period, t(p)
                                                 0.000
                                                                     0.000
Proportion time blocked, p
Computation 3-Platoon Event Periods
                                           Result
                                           0.000
p(2)
p(5)
                                           0.000
p(dom)
p (subo)
Constrained or unconstrained?
Proportion
unblocked
                             (1)
                                              (2)
for minor
                                               Two-Stage Process
                         Single-stage
movements, p(x)
                           Process
                                           Stage I
                                                            Stage II
p(1)
p(4)
p(7)
p(8)
p(9)
p(10)
p(11)
p(12)
Computation 4 and 5
Single-Stage Process
                                        7
Movement
                         1
                                 4
                                                8
                                                              10
                                                                     11
                                                                             12
                         L
                                 L
                                                             . Г
                                                                      T
                                                                              R
⊽c,x
                        469
                                                              1072
                                                                     1072
                                                                             441
s
Рx
V c,u,x
  r,x
J plat,x
Two-Stage Process
                      7
                                       8
                                                       10
                                                                        11
```

Stagel Stage2 Stage1 Stage2	Stagel	Stage2	Stage1	Stage
V(c,x)				
S		1500		1500
P(x)				
V(c,u,x)				
C(r,x)				
C(plat,x)				· <u>-</u>
Worksheet 6-Impedance and Capacity Equations				
Step 1: RT from Minor St.	9	<u>.</u>	12	
Conflicting Flows	<del></del>		441	
Potential Capacity			615	
Pedestrian Impedance Factor	1.00		1.00	
Movement Capacity			615	
Probability of Queue free St.	1.00		0.90	
Step 2: LT from Major St.	4		1	
Conflicting Flows	<del></del>		469	
Potential Capacity			1087	
Pedestrian Impedance Factor	1.00		1.00	
Movement Capacity			1087	
Probability of Queue free St.	1.00		0.97	
Maj L-Shared Prob Q free St.			0.96	
Rep 3: TH from Minor St.	8		11	
Conflicting Flows	-		1072	
Potential Capacity		-	221	
Pedestrian Impedance Factor	1.00		1.00	
Cap. Adj. factor due to Impeding mymnt	0.96		0.96	
Movement Capacity			212	
Probability of Queue free St.	1.00		1.00	
Step 4: LT from Minor St.	7		10	
Conflicting Flows			1072	
Potential Capacity			244	
Pedestrian Impedance Factor	1.00		1.00	
Maj. L, Min T Impedance factor	0.96			
Mai I Min T Ada Imp Factor	0 07			

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St. 11 8

0.97

0.87

0.97

237

Part 1 - First Stage Conflicting Flows otential Capacity

Pedestrian Impedance Factor

Cap. Adj. factor due to Impeding mymnt Movement Capacity

Maj. L, Min T Adj. Imp Factor. Cap. Adj. factor due to Impeding mymnt

Movement Capacity

Probability of Queue free St.

y C t			 237	
Results for Two-stage process: a y			 	
Maj. L, Min T Adj. Imp Factor. Cap. Adj. factor due to Impeding Movement Capacity	mvmnt	0.97 0.87	0.97 237	
Part 3 - Single Stage Conflicting Flows Potential Capacity Pedestrian Impedance Factor Maj. L, Min T Impedance factor		1.00	1072 244 1.00	******
Part 2 - Second Stage Conflicting Flows Potential Capacity Pedestrian Impedance Factor Cap. Adj. factor due to Impeding Movement Capacity	mvmnt			
Part 1 - First Stage Conflicting Flows Potential Capacity Pedestrian Impedance Factor Cap. Adj. factor due to Impeding Movement Capacity	mvmnt			•
Step 4: LT from Minor St.		 7	 10	
Result for 2 stage process: a y C t Probability of Queue free St.		1.00	212 1.00	
Part 3 - Single Stage Conflicting Flows Potential Capacity Pedestrian Impedance Factor Cap. Adj. factor due to Impeding Movement Capacity	mvmnt	1.00 0.96	1072 221 1.00 0.96 212	
Potential Capacity Pedestrian Impedance Factor Cap. Adj. factor due to Impeding Movement Capacity	mvmnt			

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
C sep				237	212	615
Volume				59	0	63
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh					347	
SUM C sep						
n .						
C act						

### Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	LT						LTR	
v (vph)	31					· · · · · · · · · · · · · · · · · · ·	122	
C(m) (vph)	1087						347	
v/c	0.03						0.35	
95% queue length	0.09						1.54	
Control Delay	8.4						20.9	
ios	Α						С	
Approach Delay							20.9	
Approach LOS							C	

## Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.97	1.00
v(il), Volume for stream 2 or 5	569	
v(i2), Volume for stream 3 or 6	0	
s(il), Saturation flow rate for stream 2 or 5	1800	
s(i2), Saturation flow rate for stream 3 or 6	1800	
P*(0j)	0.96	
d(M,LT), Delay for stream 1 or 4	8.4	
N, Number of major street through lanes	1	
d(rank,1) Delay for stream 2 or 5	0.4	

### HCS2000: Unsignalized Intersections Release 4.1d

#### TWO-WAY STOP CONTROL SUMMARY

Analyst:

v (vph)

v/c

C(m) (vph)

95% queue length

Control Delay

Approach Delay

Approach LOS

32

1057

0.03

0.09

8.5

Α

TR

Agency/Co.:

McMillen Engineering

Date Performed:

10/2/2005

Analysis Time Period: Saturday Base

Route 40/ Hawes Road

Intersection:

Jurisdiction:

Units: U. S. Customary Analysis Year:

2006

Project ID: Route 40 and Hawes Road

East/West Street:

Route 40

North/South Street:

Hawes Road

Intersection Orientation: EW

Study period (hrs): 0.25

48

274

0.18

0.62

20.9 С

20.9

С

Vel	nicle Vol	umes an	d Adjı	ıstments		
Major Street: Approach	Ea	stbound			Westbour	nd
Movement	1	2	3	4	5	6
	L	${f T}$	R	l L	T	R
Volume	25	610			392	21
Peak-Hour Factor, PHF	0.78	0.84			0.84	1 0.58
Hourly Flow Rate, HFR	32	726			466	36
Percent Heavy Vehicles	3					
Median Type/Storage RT Channelized?	Undiv	ided		/		
Lanes	0	. 1			1	0
Configuration	L					TR
Upstream Signal?		No			No	
Minor Street: Approach	No	rthbound	<u>i</u>		Southbou	ınd
Movement	7	8	9	1 10		12
	L	T	R	ĹL	${f T}^-$	. R
Volume				19	0	14
Peak Hour Factor, PHF	,			0.	79 0.50	0.58
Hourly Flow Rate, HFR				24	0	24
Percent Heavy Vehicles				3	. 3	3
Percent Grade (%)		-5			-10	
Flared Approach: Exists?	/Storage			/		No /
Lanes	_				0 1	0
Configuration					LTR	
Delay,	Queue Len	igth, an	d Lev	el of S	ervice	
Approach EB	WB	Nort	hboun	d	Sou	thbound
Movement 1	4	7	8	9	10	11 12
Lane Config LT					ł	LTR

Phone: E-Mail: Fax:

TWO-WAY STOP CONTROL (TWSC) ANALYSIS\_

Analyst:

Agency/Co.:

McMillen Engineering

Date Performed:

10/2/2005

Analysis Time Period: Saturday Base

Intersection:

Route 40/ Hawes Road

Jurisdiction:

Units: U. S. Customary

Analysis Year:

2006

Project ID: Route 40 and Hawes Road

East/West Street:

Route 40

North/South Street:

Hawes Road

Intersection Orientation: EW

Study period (hrs): 0.25

	Vehicle	Volumes	and	Adjustmen	ts		
Major Street Movements	_ 1	2	3	4	5	б	
•	L	T	R	L	${f T}$	R	
Volume	25	610			392	21	<del></del>
Peak-Hour Factor, PHF	0.78	0.84			0.84	0.58	
Peak-15 Minute Volume	' 8	182			117	9	
Hourly Flow Rate, HFR	32	726			466	36	
Percent Heavy Vehicles	3						
Median Type/Storage RT Channelized?	Undi	vided		/			
Lanes	0	1			1	0	
Configuration	Ţ	T			$\mathbf{T}$	R	
Upstream Signal?		МО			No		
Minor Street Movements	7	8	9	10	11	12	<del>-</del>
	${f L}$	T	R	${f L}$	T	R	
Volume				19	0	14	
Peak Hour Factor, PHF				0.79	0.50	0.58	
Peak-15 Minute Volume				6	0	6	
Hourly Flow Rate, HFR				24	0	24	
Percent Heavy Vehicles				3	3	3	
Percent Grade (%)		-5			-10		
Flared Approach: Exist	s?/Storag	е		/		ИО	/
RT Channelized?				_		_	
Lanes				0	_	)	
Configuration					LTR		

	Pedestrian	Volumes	and Adj	ustments	
Movements	13	14	15	16	
Flow (ped/hr)	0	0	0	0	

 Lane Width (ft)
 12.0
 12.0
 12.0
 12.0

 Walking Speed (ft/sec)
 4.0
 4.0
 4.0
 4.0

 Percent Blockage
 0
 0
 0
 0

-				Upstream	m Signa	1 Data			
	-	Prog. Flow vph	Sat Flo vph	w Тур	е т		-	Prog. Speed mph	Distance to Signa feet
Thr S5 Lef	t-Turn ough t-Turn ough								aran kanar 1936 biyan dikur kata 1936 a - Amilya
Workshe	et 3-Data	for C	omputin	g Effect					
						Movemen	it 2	Movemen	nt 5
Shared Sat flo Sat flo	<pre>ln volume ln volume w rate, m w rate, m of major</pre>	, maĵo: ajor tl ajor ri	r rt vel h vehic t vehic	nicles: les: les:'	:	726 0 1800 1800 1			
Workshe	et 4-Crit	ical Ga	ap and 1	Follow-u	p Time	Calcul	ation		
Critica Movemen	l Gap Cal t	culatio 1 L	on 4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,hv) P(hv) t(c,g)		4.1 1.00 3	1.00	1.00 0.20 -0.05	1.00 0.20 -0.05	1.00 0.10 -0.05	7.1 1.00 3 0.20 -0.10	6.5 1.00 3 0.20 -0.10	6.2 1.00 3 0.10 -0.10
t(c,hv) P(hv) t(c,g) Grade/10 t(3,lt) t(c,T):		1.00 3 0.00 0.00 0.00	0.00	0.20	0.20	0.10	1.00 3 0.20	1.00 3 0.20	1.00 3 0.10
t(c,hv) P(hv) t(c,g) Grade/10 t(3,lt) t(c,T):	1-stage 2-stage 1-stage 2-stage	1.00 3 0.00 0.00 0.00 4.1	0.00	0.20 -0.05 0.00	0.20 -0.05 0.00	0.10 -0.05 0.00	1.00 3 0.20 -0.10 0.70 0.00 1.00	1.00 3 0.20 -0.10 0.00 0.00	1.00 3 0.10 -0.10 0.00 0.00
t(c,base t(c,hv) P(hv) t(c,g) Grade/10 t(3,lt) t(c,T): t(c) Follow-t Movement t(f,base t(f,hv) P(HV)	1-stage 2-stage 1-stage 2-stage Jp Time Ca	0.00 0.00 0.00 0.00 4.1	0.00 0.00	0.20 -0.05 0.00 1.00	0.20 -0.05 0.00 1.00	0.10 -0.05 0.00 0.00	1.00 3 0.20 -0.10 0.70 0.00 1.00 6.4	1.00 3 0.20 -0.10 0.00 0.00 1.00 6.5	1.00 3 0.10 -0.10 0.00 0.00 0.00 6.2
t(c,hv) P(hv) t(c,g) Grade/10 t(3,lt) t(c,T): t(c)  Follow-t Movement  t(f,base c(f,HV) c(HV) c(f)	1-stage 2-stage 1-stage 2-stage Jp Time Ca	1.00 3 0.00 0.00 0.00 4.1 1 L 2.20 0.90 3 2.2	0.00 0.00 zions 4 L	0.20 -0.05 0.00 1.00	0.20 -0.05 0.00 1.00	0.10 -0.05 0.00 0.00	1.00 3 0.20 -0.10 0.70 0.00 1.00 6.4 10 L	1.00 3 0.20 -0.10 0.00 1.00 6.5 11 T	1.00 3 0.10 -0.10 0.00 0.00 0.00 6.2 12 R 3.30 0.90 3

```
Total Saturation Flow Rate, s (vph)
 Arrival Type
 Effective Green, g (sec)
 Cycle Length, C (sec)
 Rp (from Exhibit 16-11)
 Proportion vehicles arriving on green P
 q(q2)
 g (q)
 Computation 2-Proportion of TWSC Intersection Time
                                                         blocked
                                                Movement 2
                                                                    Movement 5
                                             V(t)
                                                    V(l,prot) V(t)
                                                                        V(1,prot
 alpha
beta
Travel time, t(a) (sec)
 Smoothing Factor, F
 Proportion of conflicting flow, f
Max platooned flow, V(c, max)
Min platooned flow, V(c,min)
Duration of blocked period, t(p)
                                                  0.000
Proportion time blocked, p
                                                                      0.000
Computation 3-Platoon Event Periods
                                            Result
                                            0.000
p(2)
p(5)
                                            0.000
p (dom)
p(subo)
Constrained or unconstrained?
Proportion
unblocked
                              (1)
                                               (2)
                                                                (3)
for minor
                         Single-stage
                                                Two-Stage Process
movements, p(x)
                           Process
                                           Stage I
                                                             Stage II
p(1)
p(4)
p(7)
p(8)
p(9)
p(10)
p(11)
p(12)
Computation 4 and 5
Single-Stage Process
Movement
                          1
                                 4
                                         7
                                                               10
                                                                      11
                                                                              12
                                                 8
                                                        9
                          L
                                                        R
                                                               L
                                                                       \mathbf{T}
                                                                               R
                         502
                                                                      1274
V c,x
                                                               1274
                                                                              484
S
Рx
V c,u,x
: r,x
C plat,x
Two-Stage Process
                      7
                                        8
                                                        10
                                                                         11
```

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stagel	Stag
V(c,x)								7.50/
\$ D()						1500		1500
P(x) V(c,u,x)								
C(r,x)				•				
C(plat,x)								
Worksheet 6-In	npedance	and Cap	acity Eq	uations				
Step 1: RT fro	m Minor	St.			9		12	
Conflicting Fl			···········				484 582	
Potential Capa Pedestrian Imp		Factor			1.00		1.00	
Movement Capac		raccor			.1		582	
Probability of		free St.			1.00		0.96	
Step 2: LT fro	m Major	St.			4		1	
Conflicting Fl							502	
Potential Capa							1057	
Pedestrian Imp		Factor			1.00		1.00	
Movement Capac		C 0L			1 00		1057	
Probability of Maj L-Shared P					1.00		0.97 0.95	
Rtep 3: TH fro	m Minor	St.			8		11	_
Conflicting Fl							1274	
Potential Capa							168	
Pedestrian Imp					1.00		1.00	
Cap. Adj. fact		to Impean	ing mymnt		0.95	•	0.95	
Movement Capac		5444 C+			1.00		159	
Probability of				-			1.00	
Step 4: LT from	m Minor	St.			7		10	
Conflicting Fl							1274	
otential Capa					- 22		185	
edestrian Impe					1.00		1.00	
Maj. L, Min T :	•	-			0.95			
Maj. L, Min T : Cap. Adj. facto				<b>-</b>	0.96 0.92		0.97	
Adj. Iacto Movement Capac:		'O TEDERT	.By mvnare	•	0.54		179	
	moutatic	on of the	 Effect	of Two-s		Accepta	ince	
lorksheet 7-Cor	iip a ba ca ca c							

Part 1 - First Stage Conflicting Flows otential Capacity

Pedestrian Impedance Factor Cap. Adj. factor due to Impeding mymnt Movement Capacity

Probability of Queue free St.

							'
	Part 2 - Second Stage Conflicting Flows Potential Capacity						
	Pedestrian Impedance Factor Cap. Adj. factor due to Impeding mvmr Movement Capacity	nt					
	Part 3 - Single Stage Conflicting Flows Potential Capacity Pedestrian Impedance Factor Cap. Adj. factor due to Impeding mymn Movement Capacity	ıt		1.00		1274 168 1.00 0.95 159	١
	Result for 2 stage process:					_	
	a Y C t Probability of Queue free St.		1	1.00	,	159 1.00	
	Step 4: LT from Minor St.			7		10	
	Part 1 - First Stage Conflicting Flows Potential Capacity Pedestrian Impedance Factor Cap. Adj. factor due to Impeding mvmn Movement Capacity	t					
	Part 2 - Second Stage Conflicting Flows Potential Capacity Pedestrian Impedance Factor Cap. Adj. factor due to Impeding mvmn Movement Capacity	t					
	Part 3 - Single Stage Conflicting Flows Potential Capacity Pedestrian Impedance Factor		1	00		1274 185 1.00	
•	Maj. L, Min T Impedance factor Maj. L, Min T Adj. Imp Factor. Cap. Adj. factor due to Impeding mymn	<del>!-</del>	0 <b>0</b>	.95 .96		0.97	
	Movement Capacity	-	-			179	
	Results for Two-stage process:						
	y C t					179	
	Worksheet 8-Shared Lane Calculations						
	Movement	7 L	8 T	9 R	10 L	11 T	12 R
	Volume (vph) Movement Capacity (vph) Shared Lane Capacity (vph)		•		24 179	0 159 274	24 582
							<del> </del>

# Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement				7	8	9	10	11	12
				L	Т	R	L	Ŧ	P
C sep							179	159	58
Volume							24	0	24
Delay									
Q sep									
Q sep +1									
round (Qsep +1)									
n max									
C sh								274	
SUM C sep								٠	
n									
Cact									
	Queue	Length,	and	Level	of	Service			
C act Worksheet 10-Delay,			and		of		. 10	11	12
C act	Queue 1 LT	Length,		Level	of	Service	10	11 LTR	12
C act Worksheet 10-Delay, Movement Lane Config	1	4			of		10		12
Worksheet 10-Delay, Movement	1 LT	4			of		10	LTR	12
Worksheet 10-Delay, Movement Lane Config	1 LT	4			of		10	LTR 48	12
Worksheet 10-Delay,  Movement Lane Config  v (vph) C(m) (vph)	1 LT 32 1057	4			of		10	LTR 48 274	12
Worksheet 10-Delay,  Movement Lane Config  v (vph) C(m) (vph) v/c	1 LT 32 1057 0.03	4			of		10	48 274 0.18	12
C act  Worksheet 10-Delay,  Movement Lane Config  v (vph) C(m) (vph) v/c 95% queue length	1 LT 32 1057 0.03 0.09	4			of		10	48 274 0.18 0.62	12
C act  Worksheet 10-Delay,  Movement Lane Config  v (vph) C(m) (vph) v/c 95% queue length Control Delay	1 LT 32 1057 0.03 0.09 8.5	4			of		10	48 274 0.18 0.62 20.9	12

## Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.97	1.00
v(il), Volume for stream 2 or 5	726	
v(i2), Volume for stream 3 or 6	0	
s(il), Saturation flow rate for stream 2 or 5	1800	
s(i2), Saturation flow rate for stream 3 or 6	1800	
P*(oj)	0.95	
d(M,LT), Delay for stream 1 or 4	8.5	
N, Number of major street through lanes	1	
d(rank,1) Delay for stream 2 or 5	0.4	

## HCS2000: Unsignalized Intersections Release 4.1d

### TWO-WAY STOP CONTROL SUMMARY\_

Analyst:

TR

Agency/Co :

McMillen Engineering

Date Performed:

10/2/2005

Analysis Time Period: Weekday PM Base

Intersection:

Route 40/ Marker Road

Jurisdiction:

Units: U. S. Customary Analysis Year:

2006

Project ID: Route 40 and Marker/Proposed Main Driveway

East/West Street: Route 40
North/South Street: Marker Road

Intersection Orientation: EW

Study period (hrs): 0.25

•	Veni	icle Volu	ımes an	ia Aajus	tme	nts			
Major Street:	Approach	Eas	stbound	]		Wes	stbound		
•	Movement	1	2	3		4	5	6	
		L	T	R	I	L	${f T}$	R	
			564	8		6	414		
Peak-Hour Fact	or, PHF		0.94	0.67		0.50	0.94		
Hourly Flow Ra			600	-11		12	440		
Percent Heavy		•				3			
Median Type/St		Undivi	lded			/			
RT Channelized									
Lanes			1	0		0	1		
Configuration			T	R		L.	Γ		
∏pstream Signa	11?		No				No		
Minor Street:	Approach	Nor	thboun	<u> </u>		Soi	ithbound		
	Movement	7	8	9	ł	10	11	12	
		L	T	R	Ī	L	T	R	
Volume		3	0	10	·				
Peak Hour Fact	or, PHF	0.75	0.50	0.62					
Hourly Flow Ra	te, HFR	4	0	16					
Percent Heavy	Vehicles	3	3	3					
Percent Grade	(용)		-5				3		
Flared Approac	h: Exists?/	Storage		No	/				/
Lanes .		Ō	1	0					
Configuration			LTR						

	Delay,	Queue	Le	ngt	h, and Lev	el of	Ser	vice_		
Approach	EB	WB		_	Northboun	.d		S	outhbour	nd
Movement	1	4		7	8	9		10	11	12
Lane Config		$_{ m LT}$	J		LTR		1			
v (vph)		12			20					
C(m) (vph)		963			409					
v/c		0.0	1		0.05					
95% queue length		0.0	4		0.15					
Control Delay		8.8			14.3					
os		Α			В					
Approach Delay					14.3					
Approach LOS		•			В					

Phone: E-Mail: Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst:

TR

Agency/Co.:

McMillen Engineering

Date Performed:

10/2/2005

Analysis Time Period: Weekday PM Base

Intersection:

· Route 40/ Marker Road

Jurisdiction:

Units: U. S. Customary

Analysis Year:

2006.

Project ID: Route 40 and Marker/Proposed Main Driveway

East/West Street: Route 40

North/South Street:

Marker Road

Intersection Orientation: EW

Study period (hrs):

Vehicle Volumes and Adjustments -6 Major Street Movements 1 2 3 L T R L T R /olume 8 414 564 6 0.94 Peak-Hour Factor, PHF 0.94 0.67 0.50 Peak-15 Minute Volume 150 3 3 110 12 Hourly Flow Rate, HFR 60Ô 11. 440 3 Percent Heavy Vehicles Median Type/Storage Undivided RT Channelized? Lanes 1 1. 0 Configuration TR LT No Upstream Signal? No Minor Street Movements 8 9 10  $\overline{11}$  $\overline{12}$ L  $\mathbf{T}$ R L Τ R Volume 3 Ō 10 Peak Hour Factor, PHF 0.75 0.50 0.62 Peak-15 Minute Volume 1 0 4 Hourly Flow Rate, HFR 4 0 16 Percent Heavy Vehicles 3 3 3 Percent Grade (%) -5 3 Flared Approach: Exists?/Storage No RT Channelized? Lanes 0 1 0 Configuration LTR

	Pedestrian	Volumes	and Ad	justments		
Movements	13	. 14	15	16	•	
Flow (ped/hr)	0	Ō	0	0		

Lane Width (ft) 12.0 12.0 12.0 12.0 Walking Speed (ft/sec) 4.0 4.0 4.0 4.0 Percent Blockage 0 0 0 0

				Upstream				<del>_</del>	
		Prog. Flow vph	Sat Flo vph	w Тур	e 1		Cycle Length sec	Prog. Speed mph	Distance to Signa feet
S2 Left-1 Throug S5 Left-1 Throug	jh Turn								
Worksheet	3-Data	for C	omputin	g Effect	t of De	elay to	Major :	Street V	ehicles
		_				Moveme	nt 2	Moveme	ent 5
Shared in Shared in Sat flow r Sat flow r Number of	volume ate, ma ate, ma	, majo: ajor th ajor rt	r rt ve n vehic c vehic	hicles: les: les:		·		440 0 1800 1800 1	
Worksheet	4-Crit	ical Ga	ap and	Follow-u	ıp Time	Calcu	lation		
Critical G Movement	ap Cal	culatio 1 L	on 4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base) t(c,hv) P(hv)		1.00	4.1 1.00 3	7.1 1.00	6.5 1.00 3	6.2 1.00 3	1.00	1.00	1.00
t(c,g) Grade/100 t(3,lt)			0.00	0.20 -0.05 0.70	0.20 -0.05 0.00	0.00		0.20 0.03	0.10 0.03
2 t(c) 1	-stage -stage -stage -stage		0.00 0.00 4.1	0.00 1.00 6.4	0.00 1.00 6.5	0.00 0.00 6.2	0.00	0.00 1.00	0.00
Follow-Up Movement	Time Ca	lculat 1 L	ions 4 L	7 L	8 T	9 R	10 L	11 T	12 R
(f,base) (f,HV) P(HV)		0.90	2.20 0.90 3	3.50 0.90 3	4.00	3.30 0.90 3	0.90	0.90	0.90
Jorksheet			- 			3.3			
omputation	n 1-Que	ue Cle	arance	Time at	Upstre	eam Sig Moveme		Moz	rement 5

```
Total Saturation Flow Rate, s (vph)
 Arrival Type
 Effective Green, g (sec)
 Cycle Length, C (sec)
 Rp (from Exhibit 16-11)
 Proportion vehicles arriving on green P
 g(q1)
 g (q2)
 g (q)
Computation 2-Proportion of TWSC Intersection Time blocked
                                                Movement 2
                                                                   Movement 5
                                             V(t)
                                                    V(l,prot) V(t)
                                                                       V(1, prot)
alpha
beta
Travel time, t(a) (sec)
Smoothing Factor, F
Proportion of conflicting flow, f
Max platooned flow, V(c, max)
Min platooned flow, V(c,min)
Duration of blocked period, t(p)
                                                  0.000
                                                                     0.000
Proportion time blocked, p
Computation 3-Platoon Event Periods
                                           Result
                                           0.000
p(2)
p(5)
                                           0.000
p(dom)
p(subo)
 Constrained or unconstrained?
Proportion
unblocked
                             (1)
                                              (2)
                                                                (3)
for minor
                         Single-stage
                                               Two-Stage Process
movements, p(x)
                           Process
                                           Stage I
                                                            Stage II
p(1)
p(4)
p(7)
p(8)
p(9)
p(10)
p(11)
p(12)
Computation 4 and 5
Single-Stage Process
                                         7
Movement
                         1
                                 4
                                                8
                                                                             12
                                                        9
                                                              10
                                                                      11
                                               T
                                                               L
                                 Ĺ
                                                       R
                                                                       Τ
                                                                              R
                                611
                                       1070
V c,x
                                               1070
                                                       606
s
Рx
V c,u,x
  r,x
C plat,x
Two-Stage Process
                      7
                                       8
                                                       10
                                                                         11
```

	Stagel	Stage2	Stagel	Stage2	Stagel	Stage2	Stage1	Stag
V(c,x)	_ <del></del>	_ <del>_</del> _			<del>_</del>			<del></del>
S		1500		1500				
P(x)								
V(c,u,x)								
C(r,x) C(plat,x)						7		
Worksheet 6-I	mpedance	and Cap	acity Eq	uations				
Step 1: RT fr	om Minor	St.			9	<u> </u>	12	
Conflicting F	lows		<del>-</del>		606		:	
Potential Cap					496			
Pedestrian Im		Factor			1.00		1.00	
Movement Capa					496			
Probability o	f Queue	free St.			0.97		1.00	
Step 2: LT fr	om Major	St.			4		1	<del></del>
Conflicting F	lows	<u> </u>			611			<u></u>
Potential Cap					963			
Pedestrian Im		Factor			1.00		1.00	
Movement Capa		<b>-</b>			963		2 00	
Probability o					0.99		1.00	
Maj L-Shared	Prob Q I	ree St.			0.98			
Rtep 3: TH fr	om Minor	St.			8		. 11	
Conflicting F	lows				1070			
Potential Cap					221			-
Pedestrian Im			_		1.00		1.00	
Cap. Adj. fac		to Imped:	ing mvmn	t	0.98		0.98	
Movement Capa		<b>5</b>			217		1 00	
Probability o	r Queue :	ree St.			1.00		1.00	
Step 4: LT fr	om Minor	St.			7		10	
Conflicting F			<del>-</del>		1070		<u> </u>	
Potential Cap					244			
Pedestrian Imp					1.00		1.00	
Maj. L, Min T							0.98	
Maj. L, Min T				•	0.99		0.99	
Cap. Adj. fact Movement Capac		ro rmbear	.ng mvmnt	-	241		0.96	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St. 11

Part 1 - First Stage Conflicting Flows

otential Capacity

Pedestrian Impedance Factor

Cap. Adj. factor due to Impeding mvmnt Movement Capacity

Probability of Queue free St.

Conflicting Flows Potential Capacity			1070 221			
Pedestrian Impedance Factor			1.00		1.00	
Cap. Adj. factor due to Impeding Movement Capacity	g mvmnt		0.98 217		0.98	
Result for 2 stage process:		-				
y			017			
C t Probability of Queue free St.			217 1.00		1.00	
Step 4: LT from Minor St.	<u>-</u> .		7		10	<u>.</u>
Part 1 - First Stage Conflicting Flows						
Potential Capacity						
Pedestrian Impedance Factor						
Cap. Adj. factor due to Impeding Movement Capacity	g mvmnt					
Part 2 - Second Stage						
Conflicting Flows Potential Capacity						
Pedestrian Impedance Factor						
Cap. Adj. factor due to Impeding Movement Capacity	g mvmnt					
Part 3 - Single Stage Conflicting Flows			1070			
Potential Capacity			244			
Pedestrian Impedance Factor			1.00		1.00	
Maj. L, Min T Impedance factor Maj. L, Min T Adj. Imp Factor.		•			0.98 0.99	
Cap. Adj. factor due to Impeding	ı mvmnt	1	0.99		0.96	
Movement Capacity		;	241			
Results for Two-stage process:						
У						
C t ·	11		241			
Norksheet 8-Shared Lane Calculat	ions					
Movement	7	8	9	10	11	1
	L	T	R	L	Т	
Volume (vph) Movement Capacity (vph)	4 241	0 217	16 496			

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement		_		7 L	8 T	9 R	10 I		
C sep				241	217				
Volume				4	0	16		•	
Delay									
Q sep									
Q sep +1									
round (Qsep +1)									
n max									
C sh					409				
SUM C sep									
n									
C act									
Worksheet 10-Delay Movement	, Queue	Length,	and		of	Service			
Inno Confid		-	,	8	מת	9	10	11	12
Lane Config		LT	,		rr	9	10	11	12
v (vph)	_	LT 12		L'		9	10	11	12
v (vph) C(m) (vph)	_	LT 12 963		20 40	9	9	10	11	12
v (vph) C(m) (vph)		12 963 0.01		20 -409 0.1	9 05	9	10	11	12
v (vph) C(m) (vph) v/c 95% queue length	_	12 963 0.01 0.04		20 409 0.0	9 05 15	9	10	11	12
v (vph) C(m) (vph) v/c 95% queue length Control Delay		12 963 0.01 0.04 8.8	,	20 40: 0.: 14	9 05 15	9	10	11	12
v (vph) C(m) (vph) v/c 95% queue length Control Delay		12 963 0.01 0.04	,	20 -40: 0.: 14 B	9 05 15	9	10	11	12
v (vph) C(m) (vph) v/c 95% queue length Control Delay	_	12 963 0.01 0.04 8.8		20 40: 0.: 14	9 05 15	9	10	11	12

	Movement 2	Movement 5
p(oj)	1.00	0.99
v(il), Volume for stream 2 or 5		440
v(i2), Volume for stream 3, or 6		0
s(il), Saturation flow rate for stream 2 or 5		1800
s(i2), Saturation flow rate for stream 3 or 6		1800
P*(oj)		0.98
d(M,LT), Delay for stream 1 or 4		8.8
N, Number of major street through lanes		1
d(rank,1) Delay for stream 2 or 5		0.1

#### TWO-WAY STOP CONTROL SUMMARY

Analyst:

Agency/Co.: McMillen Engineering

ΤŔ

Date Performed: 10/2/2005 Analysis Time Period: Saturday Base

Intersection:

Route 40/ Marker Road

Jurisdiction:

Units: U. S. Customary
Analysis Year: 2006

Project ID: Route 40 and Marker/Proposed Main Driveway

East/West Street: Route 40
North/South Street: Marker Road

Intersection Orientation: EW Study period (hrs): 0.25

	Vehicle	Vo.	lumes a	nd Adju	stme	nts_			
Major Street: Approa	ch	Εá	astboun	d		We	estbounc	i	
Moveme	nt 1		2	3	1	4	5	6	
	L		T	R	1	L	T	R	
Volume			552	3		5	409		
Peak-Hour Factor, PHF			0.80	0.75		0.62	0.87		
Hourly Flow Rate, HFR			689	4		8	470		
Percent Heavy Vehicle						3			
Median Type/Storage		ndiv	rided			/			
RT Channelized?						•			
Lanes			1	0		0	1		
Configuration				TR		I	LT		
Upstream Signal?	•		Nо				ИО		
Minor Street: Approa	ch	No	rthbou	nd		Sc	outhboun	id	
Moveme	nt 7		8	9	I	10	11	12	
•	L		T	R	1	L	T	R	
Volume	4	_	0	5		. <u> </u>	<del></del>		
Peak Hour Factor, PHF	1	.00	0.50	0.42					
Hourly Flow Rate, HFR	4		0	11					
Percent Heavy Vehicles	s 3		3	3 ·					
Percent Grade (%)			-5				3		
Flared Approach: Exis	sts?/Sto:	rage		No	1				1
Lanes		ő	1	0					
Configuration			LTR						
ne1:	ıy, Queue	ם, ז	náth. a	and Leve	1 0	F Serv	ice	***************************************	
Approach EE				thbound				hbound	!
Movement 1	4	ì	7	8	9	ı		11	12
Lane Config	LT	j		LTR		j			

	_Delay,	Queue	Le	nġth	, and Leve	el of	Ser	vice_		
Approach	EB E	WB		-	Northbound	d:		S	outhbour	nd
Movement	1	4	j	7	8	9	- 1	10	11	12
Lane Config		LT	J		LTR		1			
v (vph)		8			15					
C(m) (vph)		898			341					
v/c		0.03	1		0.04					
95% gueue length		0.03	3		0.14					
Control Delay		9.0			16.0					
os		A			С					
Approach Delay					16.0					
Approach LOS					С					

Phone: E-Mail: Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS\_

Analyst: TR

Agency/Co.: McMillen Engineering

Date Performed: . 10/2/2005 Analysis Time Period: Saturday Base

Intersection: Route 40/ Marker Road

Jurisdiction:

Units: U. S. Customary Analysis Year: 2006

Project ID: Route 40 and Marker/Proposed Main Driveway

East/West Street: Route 40 North/South Street: Marker Road

Intersection Orientation: EW Study period (hrs): 0.25

	Vehicle '	Volumes	and Ad	justmen	ts		
Major Street Movements	1	2	3	4	5	6	
-	L	T	R	L	T	R	
Volume		552	3		409		
Peak-Hour Factor, PHF		0.80	0.75	0.62	0.87		
Peak-15 Minute Volume		172	1	2	118		
Hourly Flow Rate, HFR		689	4	8	470		
Percent Heavy Vehicles				3			
Median Type/Storage RT Channelized?	Undi	vided		/			
Lanes		1	0	0	1		
Configuration		_	R	L'	יי		
Upstream Signal?		No	••	_	No		
Minor Street Movements	7	8	9	10	11	12	
	L	T	R	L	T	R	
Volume	4	0	5				
Peak Hour Factor, PHF	1.00	0.50	0.42				
Peak-15 Minute Volume	1	0	3				
Hourly Flow Rate, HFR	4	0	11				
Percent Heavy Vehicles	3	3	3				
Percent Grade (%)		-5			3		
Flared Approach: Exists RT Channelized?	?/Storage	<b>:</b>	No	/			/
Lanes	0	1	0				
Configuration		LTR					

Movements	Pedestrian 13	Volumes . 14		justments <sub>-</sub> 16	
Flow (ped/hr)	0	0	0	0	

Lane Width (ft) 12.0 12.0 12.0 12.0 Walking Speed (ft/sec) 4.0 4.0 4.0 4.0 Percent Blockage 0 0 0 0

			Upstream					
	Prog. Flow vph	Sat Flo vph	ъ Тур	e T.		ycle ength sec	Prog. Speed mph	Distance to Signa feet
S2 Left-Turn							· · · · ·	
Through S5 Left-Turn Through								
Worksheet 3-Da	ata for C	omputin	g Effect	of De	lay to	Major S	Street V	ehicles
			·	1	Movemen	t 2	Moveme	nt 5
Shared in volu Shared in volu Sat flow rate, Sat flow rate, Number of majo	me, majo: major tl major r	r rt ve h vehic t vehic	hicles: les: les:				470 0 1800 1800	
Worksheet 4-Cr	itical G	ap and	Follow-u	ıp Time	Calcul	ation		
Gritical Gan C	Calculatio	າກ						
	Calculatio 1 L	on <b>4</b> L	7 L	8 T	9 R	10 L	11 T	. 12 R
Movement t(c,base) t(c,hv)	1	4						
Movement  t(c,base) t(c,hv) P(hv) t(c,g) Grade/100	1 L	4 . 1 1 . 00 3	7.1 1.00 3 0.20 -0.05	T 6.5 1.00 3 0.20 -0.05	R 6.2 1.00 3 0.10 -0.05	1.00 0.20	Т	R
Movement  t(c,base) t(c,hv) P(hv) t(c,g) Grade/100 t(3,lt) t(c,T): 1-sta 2-sta	1 L 1.00 ge 0.00 ge 0.00 ge	4 . 1 1 . 00	7.1 1.00 3 0.20	6.5 1.00 3 0.20	R 6.2 1.00 3 0.10	1.00 0.20	1.00 0.20	1.00 0.10
2-sta t(c) 1-sta	1 L 1.00 ge 0.00 ge 0.00 ge ge	4.1 1.00 3 0.00 0.00 0.00 4.1	7.1 1.00 3 0.20 -0.05 0.70 0.00 1.00	T 6.5 1.00 3 0.20 -0.05 0.00 0.00 1.00	R 6.2 1.00 3 0.10 -0.05 0.00 0.00 0.00	1.00 0.20 0.03	1.00 0.20 0.03 0.00	R 1.00 0.10 0.03
Movement  t(c,base) t(c,hv) P(hv) t(c,g) Grade/100 t(3,lt) t(c,T): 1-sta 2-sta t(c) 1-sta 2-sta Follow-Up Time	1 L 1.00 ge 0.00 ge 0.00 ge ge	4.1 1.00 3 0.00 0.00 0.00 4.1	7.1 1.00 3 0.20 -0.05 0.70 0.00 1.00 6.4	T 6.5 1.00 3 0.20 -0.05 0.00 0.00 1.00 6.5	R 6.2 1.00 3 0.10 -0.05 0.00 0.00 0.00 6.2	1.00 0.20 0.03 0.00 1.00	1.00 0.20 0.03 0.00 1.00	R 1.00 0.10 0.03 0.00 0.00
Movement  (c,base) (c,hv) (c,hv) (c,g) Grade/100 (3,lt) (c,T): 1-sta 2-sta (c) 1-sta 2-sta Follow-Up Time	1 L 1.00 ge 0.00 ge 0.00 ge ge	4.1 1.00 3 0.00 0.00 0.00 4.1	7.1 1.00 3 0.20 -0.05 0.70 0.00 1.00 6.4	T 6.5 1.00 3 0.20 -0.05 0.00 0.00 1.00 6.5	R 6.2 1.00 3 0.10 -0.05 0.00 0.00 6.2	1.00 0.20 0.03 0.00 1.00	1.00 0.20 0.03 0.00 1.00	R 1.00 0.10 0.03 0.00 0.00

```
Total Saturation Flow Rate, s (vph)
 Arrival Type
Effective Green, g (sec)
 Cycle Length, C (sec)
Rp (from Exhibit 16-11)
 Proportion vehicles arriving on green P
g(q1)
g (q2)
g(q)
Computation 2-Proportion of TWSC Intersection Time
                                                       blocked
                                               Movement 2
                                                                  Movement 5
                                            V(t)
                                                               V(t)
                                                   V(l,prot)
                                                                       V(1,prot)
alpha
beta
Travel time, t(a) (sec)
Smoothing Factor, F
Proportion of conflicting flow, f
Max platooned flow, V(c, max)
Min platooned flow, V(c,min)
Duration of blocked period, t(p)
                                                 0.000
                                                                    0.000
Proportion time blocked, p
Computation 3-Platoon Event Periods
                                           Result
                                           0.000
p(2)
p(5)
                                           0.000
p(dom)
p(subo)
Constrained or unconstrained?
Proportion
unblocked
                             (1)
                                              (2)
                                                               (3)
for minor
                                               Two-Stage Process
                         Single-stage
movements, p(x)
                           Process
                                           Stage I
                                                            Stage II
p(1)
p(4)
p(7)
(8)q
p(9)
p(10)
p(11)
p(12)
Computation 4 and 5
Single-Stage Process
Movement
                         1
                                                             10
                                                                     11
                                                                             12
                         L
                                 L
                                               T
                                                       R
                                                                      Т
                                                                             R
V c,x
                                693
                                       1177
                                              1177
                                                      691
5
Рx
V c,u,x
  r,x
င plat,x
Two-Stage Process
                      7
                                       8
                                                       10
                                                                        11
```

/(c,x)	1500	1500	
5 ? (x)	1500	1300	
V(c,u,x)			
C(r,x)			
C(plat,x)			
Worksheet 6-Imped	ance and Capacity Equ	ations	
Step 1: RT from M	inor St.	9	12
Conflicting Flows		. 691	
Potential Capacit		443	
Pedestrian Impeda		1.00	1.00
Movement Capacity		443	
Probability of Qu	eue free St.	0.98	1.00
Step 2: LT from M	ajor St.	4	1
Conflicting Flows		693	
Potential Capacit	У	898	
Pedestrian Impeda	nce Factor	1.00	1.00
Movement Capacity		8 <b>98</b>	
Probability of Que	eue free St.	0.99	1.00
Maj L-Shared Prob	Q free St.	0.99	
Step 3: TH from M.	inor St.	. 8	11
Conflicting Flows		1177	
Potential Capacity	v ·	· 191	
Pedestrian Impedar		1.00	1.00
	due to Impeding mymnt		0.99
Movement Capacity	1	189	
Probability of Que	eue free St.	1.00	1.00
Step 4: LT from Mi	inor St.	7	10
Conflicting Flows	<del></del>	1177	
Potential Capacity	ı	211	
Pedestrian Impedar		1.00	1.00
Maj. L, Min T Impe			0.99
Maj. L, Min T Adj.			0.99
	lue to Impeding mymnt	0.99	0.97
Novement Capacity		209	
Jorksheet 7-Comput	ation of the Effect	of Two-stage Gap Acce	ptance
Step 3: TH from Mi	nor St.	8	

Conflicting Flows otential Capacity

Pedestrian Impedance Factor

Cap. Adj. factor due to Impeding mymnt Movement Capacity

Probability of Queue free St.

Movement	7 L	8 T	9 R .	10 L	11 T	1
Worksheet 8-Shared Lane Calculati	 ons					
y C t		2	209			
Results for Two-stage process: a	•					
Movement Capacity			209			
Maj. L, Min T Adj. Imp Factor. Cap. Adj. factor due to Impeding	mvmnt	ſ	).99		0.99 0.97	
Pedestrian Impedance Factor Maj. L, Min T Impedance factor			1.00		1.00 0.99	
Potential Capacity			211		1 00	
Part 3 - Single Stage Conflicting Flows			1177			
Potential Capacity Pedestrian Impedance Factor Cap. Adj. factor due to Impeding Movement Capacity	mvmnt					~. <u>-</u>
Part 2 - Second Stage Conflicting Flows						
Part 1 - First Stage Conflicting Flows Potential Capacity Pedestrian Impedance Factor Cap. Adj. factor due to Impeding Movement Capacity	mvmnt					· ·
Step 4: LT from Minor St.			7		10	)
C t Probability of Queue free St.			189 1.00		1.00	)
Result for 2 stage process: a y		<del></del>	•			
Conflicting Flows Potential Capacity Pedestrian Impedance Factor Cap. Adj. factor due to Impeding Movement Capacity	mvmnt		1177 191 1.00 0.99 189		1.00 0.99	
Part 3 - Single Stage	<del>-</del> -			<u></u>		<del>-</del>
Potential Capacity Pedestrian Impedance Factor Cap. Adj. factor due to Impeding Movement Capacity	mvmnt					

# Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement			7 L		8 T	9 R	10 I		11 T	12 F
			با			T.		1	1	1
C sep			209	9	189	443				
Volume			4		0	11				
Delay										
Q sep										
Q sep +1										
round (Qsep +1)										
n max	<del></del>									
C sh					341					
SUM C sep										
n										
C act										
	Queue	Length,	and Le	evel	of Se	ervice	<u> </u>			
C act	, Queue	Length,	and Le	evel	of Se	ervice	10	11		12
C act Worksheet 10-Delay							10	11		12
C act Worksheet 10-Delay, Movement Lane Config		4 LT		8 LT	'R		10	11		12
C act Worksheet 10-Delay, Movement Lane Config		4 LT		8 LT	'R		10	11		12
C act Worksheet 10-Delay, Movement Lane Config		4 LT		8 LT	'R		10	11		12
Worksheet 10-Delay, Movement Lane Config  v (vph) C(m) (vph) v/c 95% queue length		4 LT 8 898		8 LT 15 341	'R 		10	11		12
Worksheet 10-Delay, Movement Lane Config  v (vph) C(m) (vph) v/c 95% queue length Control Delay		4 LT 8 8 898 0.01		8 LT 15 341 0.0	'R		10	11		12
Worksheet 10-Delay, Movement Lane Config  v (vph) C(m) (vph) v/c 95% queue length		8 898 0.01 0.03		8 LT 15 341 0.0 0.1 16.	'R 4 4 0		10	11		12
Worksheet 10-Delay, Movement Lane Config  v (vph) C(m) (vph) v/c 95% queue length Control Delay		8 8 898 0.01 0.03 9.0		8 LT 15 341 0.0 0.1 16.	'R 4 4 0		10	11		12

	Movement 2	Movement 5
p(oj)	1.00	0.99
v(il), Volume for stream 2 or 5		470
v(i2), Volume for stream 3 or 6		0
s(il), Saturation flow rate for stream 2 or 5		1800
s(i2), Saturation flow rate for stream 3 or 6		1800
P*(oj)		0.99
d(M,LT), Delay for stream 1 or 4		9.0
N, Number of major street through lanes		1
d(rank, 1) Delay for stream 2 or 5		0.1

#### TWO-WAY STOP CONTROL SUMMARY

Analyst: TR

Agency/Co.: McMillen Engineering

Date Performed: 10/2/2005

Analysis Time Period: Weekday PM Base

Route 40/Smith School Hse Road Intersection:

Jurisdiction:

Jurisdiction.
Units: U. S. Customary
2006

Project ID: Route 40 and Smith School House Road Intersection

East/West Street: Route 40

North/South Street: Dinner Bell Road

Intersection Orientation: EW Study period (hrs): 0.25

	hicle Vol			ıstme			
Major Street: Approach		stbound				estbound	
Movement	1	2	3	1	4	5	6
	L	Т	R	i	${f L}$	T	R
Volume	16	558				394	8
Peak-Hour Factor, PHF	0.67	0.94				0.94	0.67
Hourly Flow Rate, HFR	23	593				419	11
Percent Heavy Vehicles	3						
Median Type/Storage RT Channelized?	Undiv	ided			/	,	
Lanes	0	1				1	0
	•	T T				T	•
Configuration	<u>د ا</u>	_					C.
Upstream Signal?	•	No				No	
Minor Street: Approach		rthboun				outhbound	
Movement	7	8	9	ı	10	11	12
·	L	T	R	1	L	T	Ř
Volume	<del></del>			••••	12	0	26
Peak Hour Factor, PHF					0.75	0.38	0.93
Hourly Flow Rate, HFR					16	0	27
Percent Heavy Vehicles					3	3	3
Percent Grade (%)						10	
Flared Approach: Exists	?/Storage			/			No /
Lanes	·	•			0	1 (	)
Configuration					_	LTR	
33.119414413		,				2111	
0.1	0		ad I ar	<u> </u>	£ 00	· · · · ·	
	Queue Lei				r pelA		bound
Approach EB Movement 1	WB 4 I		thboun 8	u 9	,		
Movement 1	4	7	a	3	ı		.1 12
Lane Config LT	1				1	7	JTR

	_Delay,	Queue	Le	ngtl	n, and Le	vel of	Sei	cvice_		
Approach	EB	WB			Northbou	nd		Sc	outhboun	d
Movement	1	4		7	8	9	1	10	11	12
Lane Config	LT		l				1		LTR	
v (vph)	23								43	
C(m) (vph)	1124								392	
v/c	0.02								0.11	
95% queue length	0.06								0.37	
. Control Delay	8.3								15.3	
os	Α								С	
Approach Delay									15.3	
Approach LOS									С	

Phone: E-Mail: Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS\_\_\_\_\_

Analyst: TR

Agency/Co.: McMillen Engineering

Date Performed: 10/2/2005

Analysis Time Period: Weekday PM Base

Intersection: Route 40/Smith School Hse Road

Jurisdiction:

Units: U. S. Customary
Analysis Year: 2006

Project ID: Route 40 and Smith School House Road Intersection

East/West Street: Route 40

North/South Street: Dinner Bell Road

Intersection Orientation: EW Study period (hrs): 0.25

	Vehicle	Volumes	and	Adjustmen	ts		
Major Street Movements	_ 1	2	3	4	5	6	
-	· L	T	Ŕ	L	Ť	R	
Volume	16	558			394	8	
Peak-Hour Factor, PHF	0.67	0.94			0.94	0.67	
Peak-15 Minute Volume	6	148			105	3	
Hourly Flow Rate, HFR	23	593			419	11	
Percent Heavy Vehicles	3						
Median Type/Storage	Undi	ivided		/			•
RT Channelized?							
Lanes	0	1			1 (	0	
Configuration	I	T			TI	R	
Upstream Signal?		No			No	•	
Minor Street Movements	7	8	9	10	1.1	12	
MINOI Beleec Movements	Ĺ	T	Ŕ	L	T	R	
-		, in the second					
Volume				12	0	26	
Peak Hour Factor, PHF				0.75	0.38	0.93	
Peak-15 Minute Volume				Ą	0	7	
Hourly Flow Rate, HFR				16	0	27	
Percent Heavy Vehicles				3	3	3	
Percent Grade (%)					10		
Flared Approach: Exists	s?/Storag	e		/		No	/
RT Channelized?							
Lanes				0	1 (	)	
Configuration					LTR		
· - <u></u>	*****	<del></del>					

	Pedestrian	Volumes	and Adj	justments_	
Movements	13	14	15	16	
Flow (ped/hr)	0	0	0	0	

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	40	4.0
Percent Blockage	0	0	0	0

	Day 2 ar				al Data		D×0~	Diatas -
	Prog. Flow vph	Sat Flow vph	Arri Typ	e '		Cycle Length sec	Prog. Speed mph	Distanc to Sign feet
S2 Left-Tur Through S5 Left-Tur Through								-
Worksheet 3-	Datá for Co	mputing	Effec	t of De	elay to	Major S	Street V	ehicles
					Moveme	nt 2	Moveme	nt 5
Shared ln vo Shared ln vo Sat flow rat Sat flow rat Number of ma	lume, major e, major th e, major rt	rt vehicle vehicle	icles: es: es:		593 0 1800 1800			
Worksheet 4-	Critical Ga	p and Fo	ollow-	up Time	e Calcu	lation		
Critical Gap	_					- 0		
lovement	1 L	4 L	7 L	. T	9 R	10 L	11 T	12 R
t(c,base)	4.1	1.00	1.00	1.00	1.00	7.1	6.5	6.2 1.00 3
t(c,hv) P(hv)	3					3	3	
P(hv) E(c,g) Grade/100 E(3,lt)	0.00		0.20	0.20	0.10	0.20 0.10 0.70	0.20 0.10 0.00	0.10 0.10 0.00
P(hv) c(c,g) Grade/100 c(3,lt) c(c,T): 1-st 2-st	_	0.00	0.20	0.20 0.00 1.00	0.10	0.20 0.10	0.20 0.10	0.10 0.10
P(hv) E(c,g) Grade/100 E(3,lt) E(c,T): 1-st 2-st C(c) 1-st 2-st	0.00 tage 0.00 tage 0.00 tage 4.1 tage	0.00	0.00	0.00	0.00	0.20 0.10 0.70 0.00 1.00 6.4	0.20 0.10 0.00 0.00 1.00 6.6	0.10 0.10 0.00 0.00 0.00 6.2
P(hv) c(c,g) Grade/100 c(3,lt) c(c,T): 1-st 2-st c(c) 1-st	0.00 tage 0.00 tage 0.00 tage 4.1 tage	0.00	0.00	0.00	0.00	0.20 0.10 0.70 0.00 1.00	0.20 0.10 0.00 0.00 1.00	0.10 0.10 0.00 0.00 0.00
P(hv) c(c,g) Grade/100 c(3,lt) c(c,T): 1-st 2-st c(c) 1-st 2-st Follow-Up Tir Movement c(f,base) c(f,HV) c(HV)	0.00 tage 0.00 tage 0.00 tage 4.1 tage  me Calculati 1 L  2.20 0.90 3	0.00 ions 4 L	0.00	0.00	0.00	0.20 0.10 0.70 0.00 1.00 6.4 10 L	0.20 0.10 0.00 0.00 1.00 6.6	0.10 0.10 0.00 0.00 0.00 6.2
P(hv) E(c,g) Frade/100 E(3,lt) E(c,T): 1-st 2-st C(c) 1-st 2-st Follow-Up Tir Movement E(f,base) E(f,HV) E(HV) E(f)	0.00 tage 0.00 tage 0.00 tage 4.1 tage  me Calculati 1 L 2.20 0.90 3 2.2	0.00 ions 4 L	0.00 1.00 7 L	0.00 1.00	0.00 0.00 9 R	0.20 0.10 0.70 0.00 1.00 6.4	0.20 0.10 0.00 0.00 1.00 6.6	0.10 0.10 0.00 0.00 0.00 6.2
P(hv) c(c,g) Grade/100 c(3,lt) c(c,T): 1-st 2-st c(c) 1-st 2-st Follow-Up Tir Movement c(f,base) c(f,HV) c(HV)	0.00 tage 0.00 tage 0.00 tage 4.1 tage  me Calculati 1 L 2.20 0.90 3 2.2	0.00 ions 4 L	0.00 1.00 7 L	0.00 1.00	0.00 0.00 9 R	0.20 0.10 0.70 0.00 1.00 6.4 10 L	0.20 0.10 0.00 0.00 1.00 6.6	0.10 0.10 0.00 0.00 0.00 6.2

```
Total Saturation Flow Rate, s (vph)
 Arrival Type
 Effective Green, g (sec)
 Cycle Length, C (sec)
 Rp (from Exhibit 16-11)
 Proportion vehicles arriving on green P
 g(q1)
 q(q2)
 g (q)
Computation 2-Proportion of TWSC Intersection Time blocked
                                                Movement 2
                                                                    Movement 5
                                             V(t)
                                                    V(l,prot) V(t)
                                                                        V(1,prot
 alpha
beta
Travel time, t(a) (sec)
Smoothing Factor, F
Proportion of conflicting flow, f
Max platooned flow, V(c, max)
Min platooned flow, V(c,min)
Duration of blocked period, t(p)
                                                                      0.000
                                                  0.000
Proportion time blocked, p
Computation 3-Platoon Event Periods
                                            Result
                                            0.000
p(2)
                                            0.000
p(5)
p (dom)
p(subo)
 Constrained or unconstrained?
Proportion
unblocked
                                               (2)
                                                                (3)
                              (1)
for minor
                         Single-stage
                                                Two-Stage Process
                           Process
                                           Stage I
                                                             Stage II
movements, p(x)
p(1)
p(4)
p(7)
(8)q
p(9)
p(10)
p(11)
p(12)
Computation 4 and 5
Single-Stage Process
Movement
                          1
                                 4
                                         7
                                                               10
                                                                      11
                                                                              12
                          L
                                 L
                                         Ľ
                                                        R
                                                                L
                                                                       Υ
                                                                               R
                         430
                                                               1063
                                                                      1063
                                                                              424
V c,x
S
p_{\mathbf{X}}
V c,u,x
  r,x
C plat,x
Two-Stage Process
                      7
                                        8
                                                        10
                                                                        11
```

V(c,x)	· ·		
S		1500	150
P(x) .			
V(c,u,x)			
C(r,x)			
C(plat,x)	<b></b>		
Worksheet 6-Impedance and Capacity Equation	ons	<del></del>	
Step 1: RT from Minor St.	9	12	
Conflicting Flows		424	
Potential Capacity		627	
Pedestrian Impedance Factor	1.00	1.00	
Movement Capacity		627	
Probability of Queue free St.	1.00	0.96	
Step 2: LT from Major St.	4	1	
Conflicting Flows		430	
Potential Capacity		1124	
Pedestrian Impedance Factor	1.00	1.00	
Movement Capacity	1 00	1124	
Probability of Queue free St.	1.00	0.98	
Maj L-Shared Prob Q free St.		0.97	
Rtep 3: TH from Minor St.	8	11	
Conflicting Flows		1063	
Potential Capacity	1 00	221	
Pedestrian Impedance Factor	1.00	1.00	
Cap. Adj. factor due to Impeding mymnt	0.97	0.97	
Movement Capacity	1 00	214	
Probability of Queue free St.	1.00	1.00	
Step 4: LT from Minor St.	7	10	
Conflicting Flows	<del></del>	1063	
Potential Capacity		245	
Pedestrian Impedance Factor	1.00	1.00	
Maj. L, Min T Impedance factor	0.97		
Maj. L, Min T Adj. Imp'Factor.	0.98		
Cap. Adj. factor due to Impeding mymnt	0.93	0.98	
Movement Capacity		240	

11

Part 1 - First Stage
Conflicting Flows
otential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mymnt
Movement Capacity
Probability of Queue free St.

Step 3: TH from Minor St.

			1063	
<del>-</del>	תח י			
			214	
			214	
1	00		1.00	
	7	<del></del>		
		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		
		-		
		**		
		•		
			•	
1	nn			
			1.00	
0	.98			
			0.98	
	_		240	
			240	
A-1-1-1-1				
8	9	10	11	1
Т	ĸ	L-	T	
		16	0 214	 2 6
		240	* * * **	
	1 0 0 0 0 0	1.00 0.97 0.98 0.93	1.00 7 1.00 0.97 0.98 0.93 8 9 10 T R L	1.00 1.00 0.97 214  1.00 1.00  7 10  1063 245 1.00 1.00 0.97 0.98 0.93 0.98 240  240

. .

.

•

t

# Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
C sep		<del></del>	·· ·· · · -	240	214	62
Volume				16	0	27
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max	<del></del>			· · · · · · · · · · · · · · · · · · ·	<del></del>	
C sh					392	
SUM C sep						
n į						
C act						

## Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	LT						LTR	
v (vph)	23						43	-
C(m) (vph)	1124						392	
v/c	0.02						0.11	
95% queue length	0.06				,		0.37	
Control Delay	8.3						15.3	
os	A						С	
Approach Delay							15.3	
Approach LOS							С	

	Movement 2	Movement 5
p(oj)	0.98	1.00
v(il), Volume for stream 2 or 5	593	
v(i2), Volume for stream 3 or 6	0	
s(il), Saturation flow rate for stream 2 or 5	1800	
s(i2), Saturation flow rate for stream 3 or 6	1800	
P*(oj)	0.97	
d(M,LT), Delay for stream 1 or 4	8.3	
N, Number of major street through lanes	1	
d(rank,1) Delay for stream 2 or 5	0.3	

#### TWO-WAY STOP CONTROL SUMMARY

Analyst:

TR

Agency/Co.:

McMillen Engineering

Date Performed:

10/2/2005

Analysis Time Period: Saturday Peak Base

Intersection: Route 40/Smith School Hse Road

Jurisdiction:

Units: U. S. Customary Analysis Year: 2006

Project ID: Route 40 and Smith School House Road Intersection

East/West Street: Route 40

North/South Street: Dinner Bell Road

Intersection Orientation: EW

Study period (hrs): 0.25

11110100001011 01				_		20110	~ (	,	
	Veh	icle Vol	umes an	d Adju	stme	ents			
Major Street:	Approach	Ea	stbound			We	stbound	<u>d</u>	
_	Movement	1	2	3	ŀ	4	5	6	
		${f L}$	T .	R	I	L	${f T}$	R	
Volume		14	504		<del></del>		402	10	
Peak-Hour Facto	or, PHF	0.50	0.87				0.87	0.5	0
Hourly Flow Rat	e, HFR	28	579				462	20	
Percent Heavy V		3							
Median Type/Sto		Undiv	ided			/			
RT Channelized?									
Lanes		0	1				1	0	
Configuration		L'	Т				7	ΓR	
'pstream Signal	.?.		No				No		
	·								
	Approach		rthbound				uthbour		
	Movement	7	8	9	ļ	10	11	12	
		L	T	R	ļ	L	T	R	
/olume					_	8 .	0	12	
Peak Hour Facto	r, PHF				•	0.40	0.38	0.60	)
Hourly Flow Rat						19	0	19	
Percent Heavy V						3	3	3	
Percent Grade (							10		
Flared Approach		/Storage			/			No	/
Lanes						0	1	0	•
Configuration							LTR		
,									
	Dalan C			.,	. 1 .	£ 0			
Approach	beтау, Ç ЕВ	ueue Ler) WB		a Leve :hbound		r servi		hbounc	1
lovement	1	4	7	8	9	1 1		11	12
Lane Config	. LT	į		*	-	i		LTR	
		·				·			
(vph)	28							38	
(m) (vph)	1075							325	
r/c	0.03							0.12	
95% queue lengtl								0.39	
Control Delay	8.4							17.5	
OS	A							Ç	
pproach Delay								17.5	
Approach LOS								C	

Phone:

E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst:

Agency/Co.:

McMillen Engineering

Date Performed:

10/2/2005

Analysis Time Period: Saturday Peak Base

Intersection:

Route 40/Smith School Hse Road

Jurisdiction:

Units: U. S. Customary

Analysis Year:

2006

Project ID: Route 40 and Smith School House Road Intersection

East/West Street: Route 40

North/South Street:

Dinner Bell Road

Intersection Orientation: EW

Study period (hrs): 0.25

	Vehicle	Volumes	and A	djustmen	ts		
Major Street Movements	1,	2	3	4	5	6	
	L	T	R	L	Ţ	R	
<b>.</b>		·			_		
Volume	14	504			402	10	
Peak-Hour Factor, PHF	0.50	0.87			0.87	0.50	
Peak-15 Minute Volume	7	145			116	5	
Hourly Flow Rate, HFR	28	579			462	20	
Percent Heavy Vehicles	3						
Median Type/Storage	Undi	vided		/			
RT Channelized?							
Lanes	0	1			1 (	כ	
Configuration	I	ıΤ			T	3	
Upstream Signal?		Nо			ИО		
		· · · · · · · · · · · · · · · · · · ·					
Minor Street Movements	7	8	9	10	11	12	
	L	${f T}$	Ř	L	T	R	
Volume				8	0	12	
Peak Hour Factor, PHF				0.40	0.38	0.60	
Peak-15 Minute Volume				5	0	5	
Hourly Flow Rate, HFR				19	0	19	
Percent Heavy Vehicles				3	3	3	
Percent Grade (%)					10		
Flared Approach: Exists	?/Storaq	e		1		No	/
RT Channelized?	5						
Lanes				0	1 0	)	
Configuration					LTR		
				<u> </u>			

<u></u>	Pedestrian		-	justments_		-
Movements	13	14	15	7.6		
Flow (ped/hr)	0	0	0	0	-	_

12.0 12.0 12.0 12.0 Lane Width (ft) Walking Speed (ft/sec) 4.0 4.0 4.0 4.0

Per	cent Blockage		0	0	0	0		
			qU	stream S	Signal Dat	:a		
		Prog. Flow vph	Sat Flow vph	Arrival Type	Green	Cycle	Prog. Speed mph	Distance to Signal feet
sz	Left-Turn Through							
S5	Left-Turn Through							
 Wor	ksheet 3-Data	for Com	nputing	Effect o	of Delay t	o Major	Street	Vehicles
					Moven	nent 2	Movem	ent 5
	red ln volume	-			579	)		<del> </del>
	red ln volume flow rate, m				0 180	0		
Sat	flow rate, moder of major :	-	vehicle:		180	0		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical	l Gap Calc	ulati	on						
iovement	5	1	4	7	8	9	10	11	12
		L	L	L	T	R	L	T	R
c(c,base		4.1	<del></del> .				7.1	6.5	6.2
(c,hv)		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		3					3	3	3
c(c,q)				0.20	0.20	0.10	0.20	0.20	0.10
Grade/10	0						0.10	0.10	0.10
(3,1t)		0.00					0.70	0.00	0.00
:(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage		0.00	1.00	1.00	0.00	1.00	1.00	0.00
:(c)	1-stage						6.4	6.6	6.2
	2-stage								
Follow-U	Jp Time Ca	lculai	ions						· · · ·
4ovement		1	4	7	8	9	10	11	12
		L	L	L	T	R	L	T	R
(f,base	:)	2.20	•				3.50	4.00	3.30
(f,HV)	•	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
(HV)		3					3	3	3
(£)		2.2					3.5	4.0	3.3

Worksheet 5-Effect of Upstream Signals

omputation	1-Queue	Clearance	Time	at	Upstream	Signal		
					Mov	vement 2	Mov	rement 5
					V(t)	V(l,prot)	V(t)	V(l,prot)

```
Total Saturation Flow Rate, s (vph)
 Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
 Proportion vehicles arriving on green P
q(q1)
g (q2)
g(q)
Computation 2-Proportion of TWSC Intersection Time blocked
                                                Movement 2
                                                                   Movement 5
                                            V(t)
                                                    V(1,prot)
                                                                V(t)
                                                                       V(1, prot)
alpha
beta
Travel time, t(a) (sec)
Smoothing Factor, F
Proportion of conflicting flow, f
Max platooned flow, V(c, max)
Min platooned flow, V(c,min)
Duration of blocked period, t(p)
                                                                     0.000
                                                  0.000
Proportion time blocked, p
Computation 3-Platoon Event Periods
                                           Result
                                           0.000
p(2)
                                           0.000
p(5)
p(dom)
p(subo)
Constrained or unconstrained?
Proportion
unblocked.
                                               (2)
                                                                (3)
                             (1)
                                               Two-Stage Process
for minor
                         Single-stage
movements, p(x)
                           Process.
                                           Stage I
                                                            Stage II
p(1)
p(4)
p(7)
p(8)
p(9)
p(10)
p(11)
p(12)
Computation 4 and 5
Single-Stage Process
Movement
                         1
                                 4
                                        7
                                                        9
                                                              10
                                                                      11
                                                                             12
                         L
                                 L
                                        L
                                                        R
                                                               L
                                                                      Т
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V c,χ
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                                                                             472
s
Рx
V c,u,x
:r,x
C plat,x
Two-Stage Process
                      7
                                       8
                                                                         11
                                                       10
```

Stagel Stage2 Stagel Stag	e2 Stage1	Stage2	Stage1	Stag
V(c,x)	<del></del>	· <del></del>		
S		1500		1500
P(x)				
V(c,u,x)				
C(r,x) C(plat,x)			-	
Worksheet 6-Impedance and Capacity Equation	ons			
		<del></del>	10	
Step 1: RT from Minor St.	9		12	
Conflicting Flows		·	472	
Potential Capacity			589	
Pedestrian Impedance Factor	1.00		1.00	
Movement Capacity	1 00		589	
Probability of Queue free St.	1.00		0.97	
Step 2: LT from Major St.	4		1	
Conflicting Flows	·		482	_
Potential Capacity			1075	
Pedestrian Impedance Factor	1.00		1.00	
Movement Capacity	•		1075	
Probability of Queue free St.	1.00		0.97	
Maj L-Shared Prob Q free St.	•		0.96	
Step 3: TH from Minor St.	8		11	
Conflicting Flows	<del></del>		1107	
Potential Capacity			208	
Pedestrian Impedance Factor	1.00		1.00	
Cap. Adj. factor due to Impeding mymnt	0.96		0.96	
Movement Capacity			200	
Probability of Queue free St.	1.00		1.00	
Step 4: LT from Minor St.	7		10	
Conflicting Flows		<u> </u>	1107	
Potential Capacity			230	
Pedestrian Impedance Factor	1.00		1.00	
Maj. L, Min T Impedance factor	0.96			
Maj. L, Min T Adj. Imp Factor.	0.97			
Cap. Adj. factor due to Impeding mymnt	0.94		0.97	
Movement Capacity			224	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St. 11

Part 1 - First Stage Conflicting Flows otential Capacity

Pedestrian Impedance Factor

Cap. Adj. factor due to Impeding mvmnt Movement Capacity

Probability of Queue free St.

Volume (vph) Movement Capacity (vph) Shared Lane Capacity (vph)				19 224	0 200 325	19 58
Movement	7 t.	8 T	9 R	10 L	11 T	12 E
Worksheet 8-Shared Lane Calcu	ulations					
C t				···-	224	
a y	. ·					
Results for Two-stage process	s:				· 	
Maj. L, Min T Adj. Imp Facto Cap. Adj. factor due to Impe Movement Capacity	r.	C	).97 ).94		0.97 224	
Potential Capacity Pedestrian Impedance Factor Maj. L, Min T Impedance fact	or		00	•	230 1.00	
Part 3 - Single Stage Conflicting Flows	<del></del>	•			1107	<del>- ;</del> -
Part 2 - Second Stage Conflicting Flows Potential Capacity Pedestrian Impedance Factor Cap. Adj. factor due to Impe Movement Capacity	ding mvmnt					
Conflicting Flows Potential Capacity Pedestrian Impedance Factor Cap. Adj. factor due to Impe Movement Capacity	eding mvmnt	·				
Step 4: LT from Minor St.  Part 1 - First Stage		<u> </u>	7		10	_
C t Probability of Queue free St	: <b>.</b>		1.00		1.00	·
Result for 2 stage process: a y					200.	
Part 3 - Single Stage Conflicting Flows Potential Capacity Pedestrian Impedance Factor Cap. Adj. factor due to Impe Movement Capacity	eding mvmnt		1.00 0.96		1107 208 1.00 0.96 200	
Part 2 - Second Stage Conflicting Flows Potential Capacity Pedestrian Impedance Factor Cap. Adj. factor due to Impe Movement Capacity	eding mvmnt					

# Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7	8	9	10	11	12
	Ľ	T	R	L	Т	F
C sep Volume				224 19	200	58 19
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max				·		
C sh					325	
SUM C sep						
n						
C act						

## Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	LT				•		LTR	
v (vph)	28		<del>-</del>	<del></del>			38	
C(m) (vph)	1075		•				325	
v/c	0.03						0.12	
95% queue length	0.08						0.39	
Control Delay	8.4						17.5	•
GOS	Α						C	
Approach Delay							17.5	
Approach LOS							С	

	<u>.</u>
0.97	1.00
579	
0	
1800	
1800	
0.96	
8.4	
1	
0.3	
	0 1800 1800 0.96 8.4

#### TWO-WAY STOP CONTROL SUMMARY\_

Analyst:

TR

Agency/Co.:

McMillen Engineering

Date Performed:

10/2/2005

Analysis Time Period: Weekday PM Base

Intersection:

Route 40/ Dinner Bell Road

Jurisdiction:

Units: U. S. Customary

2006

Analysis Year:

Project ID: Route 40 and Dinner Bell Road Intersection

East/West Street: Route 40 North/South Street: Dinner Bell Road

Intersection Orientation: EW

Study period (hrs): 0.25

Major Street: Approach	ricle Vol: Ea:	stbounc				stboun	d	
Movement	1	2	3	]	4	5	6	
	$\mathbf{L}_{_{_{arphi}}}$	T	R	1	L	T	R	
Volume	26	508	47		14	360	38	
Peak-Hour Factor, PHF	0.81	0.94	0.78		0.58	0.94	0.79	
Hourly Flow Rate, HFR	. 32	540	60		24	382	48	
Percent Heavy Vehicles	3				3	~-		
Median Type/Storage RT Channelized?	Undiv:	ided			/			
Lanes	0	1	0		0	1	0	
Configuration	$\mathbf{L}'$	rr			L'	rr		
<pre>Ipstream Signal?</pre>		No				No		
Minor Street: Approach	No	Northbound			So	ıthbou	nd .	
Movement	7	8	9	1	10	11	12	
	L	Т	R	1	L	T	Ř	
Volume	26	7	16		36	3	15	
Peak Hour Factor, PHF	0.81	0.58	0.67		0.75	0.38	0.63	
Hourly Flow Rate, HFR	32	12	23		48	7	23	
Percent Heavy Vehicles	3	3	3		3	3	3	
Percent Grade (%)		-4				3		
Flared Approach: Exists?	/Storage		No	/			No	/
Lanes	Ō	1	0		0	1	0	
Configuration		LTR				LTR		

Approach	EB	Queue Lei WB	-	Southbound	
Movement	1	4	7 8 9	10	11 12
Lane Config	LTR	LTR	LTR	ļ	LTR
v (vph)	32	24	67		78
C(m) (vph)	1124	972	224		210
v/c	0.03	0.02	0.30		0.37
95% queue length	0.09	0.08	1.21		1.61
Control Delay	8.3	8.8	27.8		31.9
os	A	A	D		D
Approach Delay			27.8		31.9
Approach LOS			D		D

Phone: E-Mail: Fax:

TWO-WAY STOP CONTROL (TWSC) ANALYSIS

Analyst: -

Agency/Co.: McMillen Engineering

Date Performed: 10/2/2005.

Analysis Time Period: Weekday PM Base

Route 40/ Dinner Bell Road Intersection:

TR

Jurisdiction:

Units: U. S. Customary 2006 Analysis Year:

Project ID: Route 40 and Dinner Bell Road Intersection

East/West Street: Route 40

Dinner Bell Road North/South Street:

Study period (hrs): 0.25 Intersection Orientation: EW

	_Vehicle	Volume	s and A	djustmen			
Major Street Movements	1	2	3	4	5	6	
	${f L}$	T	R	L	${f T}$	R	
Volume	26	508	47	14	360	38	<del></del>
Peak-Hour Factor, PHF	0.81	0.94	0.78	0.58	0.94	0.79	
Peak-15 Minute Volume	8	135	15	6	96	12	
Hourly Flow Rate, HFR	32	540	60	24	382	48	
Percent Heavy Vehicles	3			3			
Median Type/Storage RT Channelized?	Undi	vided		/			ų.
Lánes	0	1	0	0	1	0	
Configuration	Ī.	TR	_	L'	TR	_	
Upstream Signal?		No			No		
Minor Street Movements	7	8	9	10	11	12	
	L	T	R	L	T	R	
Volume	26	7	16	36	3	15	
Peak Hour Factor, PHF	0.81	0.58	0.67	0.75	0.38	0.63	
Peak-15 Minute Volume	8	3	6	12	2	6	
Hourly Flow Rate, HFR	32	12	23	48	7	23	
Percent Heavy Vehicles	3	3	3	3	3	3	
Percent Grade (%)		-4			3		
Flared Approach: Exists	s?/Storag	e	. No	/		Nо	/
RT Channelized?	,						
Lanes	0	1	0	0	1	0	
Configuration		LTR			LTR		

Movements	Pedestrian 13		and Ad	justments 16	
Flow (ped/hr)	0	0	0	0	

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

	Upstream Signal Data											
		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet				
S2	Left-Turn Through					<del></del>	-					
\$5	Left-Turn Through											

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:	540	382
Shared ln volume, major rt vehicles:	60	. 48
Sat flow rate, major th vehicles:	1800	1800
Sat flow rate, major rt vehicles:	1800	1800
Number of major street through lanes:	1	1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical	Gap Cal	culati	on			<u> </u>				
lovement		1	4	7	8	9	10	11	12	
,		${f L}$	L	L	Ţ	R	L	T	R	
t(c,base	)	4.1	4.1	7.1	6.5	6.2	7.1	6.5	6.2	
t(c,hv)		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
P(hv)		3	3	3	3	3	3	.3	3	
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10	
Grade/10	0			-0.04	-0.04	-0.04	0.03	0 03	0.03	
t(3,1t)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	2-stage		0.00	1.00	1.00	0.00	1.00	1.00	0.00	
t(c)	1-stage		4.1	7.1	6.5	6.2	7.1	6.5	6.2	
	2-stage									
	~									
Follow-U	p Time C	alculat	cions				· · · · · · · · · · · · · · · · · · ·			
Movement		1	4	7	8	9	10	11	12	
		$\mathbf{L}$	Ļ	L	T	R	L	${f T}$	R	
t(f,base	)	2.20	2.20	3.50	4.00	3.30	3.50	4.00	3.30	
t(f,HV)		0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	
P(HV)		3	3	3	3	3	3	3	3	
t(f)		2.2	2.2	3.5	4.0	3.3	3.5	4.0	3.3	

Worksheet 5-Effect of Upstream Signals

omputation	1-Queue	Clearance	Time	at	Upstream	Signal		
					Movement 2		Mor	vement 5
					V(t)	V(1,prot)	V(t)	V(1,prot)

```
Total Saturation Flow Rate, s (vph)
 Arrival Type
 Effective Green, g (sec)
 Cycle Length, C (sec)
 Rp (from Exhibit 16-11)
 Proportion vehicles arriving on green P
 g(q1)
g(q2)
 g(q)
Computation 2-Proportion of TWSC Intersection Time blocked
                                                Movement 2
                                                                   Movement 5
                                             V(t)
                                                    V(1,prot) V(t)
                                                                       V(1,prot
alpha
beta
Travel time, t(a) (sec)
Smoothing Factor, F
Proportion of conflicting flow, f
Max platooned flow, V(c, max)
Min platooned flow, V(c,min)
Duration of blocked period, t(p)
                                                  0.000
                                                                     0.000
Proportion time blocked, p
Computation 3-Platoon Event Periods
                                           Result
p(2)
                                           0.000
p(5)
                                           0.000
p (dom)
p(subo)
 Constrained or unconstrained?
Proportion
unblocked
                             (1)
                                               (2)
                                                                (3)
for minor
                         Single-stage
                                               Two-Stage Process
movements, p(x)
                           Process
                                           Stage I
                                                            Stage II
p(1)
p(4)
p(7)
p(8)
p(9)
p(10)
p(11)
p(12)
Computation 4 and 5
Single-Stage Process
Movement
                          1
                                 4
                                         7
                                                        9
                                                              10
                                                                      11
                                                                             12
                                                8
                                                Т
                          L
                                         L
                                                        R
                                 L
                                                               L
                                                                       Т
                                                                              R
                         430
                                600
                                       1103
                                                       570
                                                                             40
V c,x
                                               1112
                                                              1106
                                                                      1118
s
Pχ
V c,u,x
  r,x
C plat,x
Two-Stage Process
                      7
                                       8
                                                        10
                                                                         11
```

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stagel	Sta
V(c,x) s P(x)		1500		1500		1500		150
V(c,u,x)			<del>- · · · - · · -</del> · · · · · · · · · · · ·					
C(plat,x)								
Worksheet 6-I	mpedance	and Cap	acity Eq	uations				
Step 1: RT fr		St.			9		12	
Conflicting F					570		406	
Potential Cap					519	•	643	
Pedestrian Im		Factor			1.00		1.00	
Movement Capa					519		643	
Probability o	f Queue	free St.			0.96		0.96	
Step 2: LT fr	om Major	St.			4		1	
Conflicting F	lows	· · ·			600		430	
Potential Cap	acity				972		1124	
Pedestrian Im	pedance	Factor			1.00	•	1.00	
Movement Capa	city			•	972		1124	
Probability o					0.98		0.97	
Maj L-Shared	Prob Q f	ree St.			0.97		0.96	
Step 3: TH fr	om Minor	St.			8		11	
Conflicting F	lows				1112	-	1118	
Potential Cap				•	208		206	
Pedestrian Im					1.00		1.00	
Cap. Adj. fac		to Impedi	ing mvmn	t	0.93		0.93	
Movement Capa		_			193		191	
Probability o	f Queue :	free St.			0.94		0.96	
Step 4: LT fr	om Minor	St.			7		10	
Conflicting F	lows			· · · · · · · · · · · · · · · · · · ·	1103		1106	
Potential Cap					188		187	
Pedestrian Imp					1.00		1.00	
Maj. L, Min T					0.89		0.87	
Maj. L, Min T					0.92		0.90	
	tor due t	o Impedi	ing mymnt	-	0.88 166		0.86	
Cap. Adj. fac		-					161	

11

Part 1 - First Stage · Conflicting Flows otential Capacity

Pedestrian Impedance Factor

Step 3: TH from Minor St.

Cap. Adj. factor due to Impeding mymnt Movement Capacity

Probability of Queue free St.

Volume (vph) Movement Capacity (vph) Shared Lane Capacity (vph)	32 166	12 193 224	23 519	48 161	7 191 210	2. 64
Movement	7 L	8 T	9 R	10 L	1.1 T	1:
Worksheet 8-Shared Lane Calculatio						
C t		. <del></del>	.66 	· <del></del> .	161	
У						
Results for Two-stage process:						
		<u> </u>		····		
Cap. Adj. factor due to Impeding m Movement Capacity	nvmnt		).88 L66		0.86 161	
Maj. L, Min T Adj. Imp Factor.	<b>-</b> -	(	).92		0.90	
Maj. L, Min T Impedance factor			).89		0.87	
Potential Capacity Pedestrian Impedance Factor			188 1.00		187 1.00	
Conflicting Flows			1103		1106	
Part 3 - Single Stage		<del></del>				
Cap. Adj. factor due to Impeding r Movement Capacity	uviiui C					
Pedestrian Impedance Factor	nemin +					
Potential Capacity						
<pre>?art 2 - Second Stage Conflicting Flows</pre>						
Cap. Adj. factor due to Impeding movement Capacity	nvmnt	·				
Pedestrian Impedance Factor			•			
Conflicting Flows Potential Capacity						
Part 1 - First Stage						
Step 4: LT from Minor St.			7		10	
C t Probability of Queue free St.			193 0.94		191 <b>0.</b> 96	
У			100		4.04	
Result for 2 stage process:						
Cap. Adj. factor due to Impeding . Movement Capacity	mvmnt		0.93 193		0.93 191	
Pedestrian Impedance Factor			1.00		1.00	
Potential Capacity			208		206	
Part 3 - Single Stage Conflicting Flows			1112		1118	
Cap. Adj. factor due to Impeding Movement Capacity	mvmnt					
Pedestrian Impedance Factor		•				
Conflicting Flows Potential Capacity						
Potential Capacity		-				

## Worksheet 9-Computation of Effect of Flared Minor Street Approaches

<del>7</del>	8	9	10	11	12
L	T	R	L	T	R
166	193	519	161	191	64
32	12	23	48	7	23
	·	<u>-</u> -			
	224			210	
				-	
-	166	L T	L T R  166 193 519 32 12 23	L T R L  166 193 519 161 32 12 23 48	L T R L T  166 193 519 161 191 32 12 23 48 7

## Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	e Config LTR LTR LTR			LTR				
v (vph)	32	24		67			78	<del></del>
C(m) (vph)	1124	972		224			210	
v/c	0.03	0.02		0.30			0.37	
95% queue length	0.09	0.08		1.21			1.61	
Control Delay	8.3	8.8		27.8			31.9	
īos -	А	Α		D			D	
Approach Delay				27.8			31.9	
Approach LOS	•			D			D	

	Movement 2	Movement 5
p(oj)	0.97	0.98
v(il), Volume for stream 2 or 5	540	382
v(i2), Volume for stream 3 or 6	60	48
s(il), Saturation flow rate for stream 2 or 5	1800	1800
s(i2), Saturation flow rate for stream 3 or 6	1800	1800
P*(oj)	0.96	0.97
d(M,LT), Delay for stream 1 or 4	8.3	8.8
N, Number of major street through lanes	1	1
d(rank,1) Delay for stream 2 or 5	0.4	0.3

#### TWO-WAY STOP CONTROL SUMMARY

Analyst:

Agency/Co.:

McMillen Engineering

Date Performed:

10/2/2005

Analysis Time Period: Saturday Base

Intersection:

Route 40/ Dinner Bell Road

Jurisdiction:

Jurisdiction.
Units: U. S. Customary
2006

Project ID: Route 40 and Dinner Bell Road Intersection

Vehicle Volumes and Adjustments

East/West Street: Route 40

North/South Street:

Dinner Bell Road

Intersection Orientation: EW

Study period (hrs): 0.25

Major Street: Approach	Ea	stbound		Westbound				
Movement	1	2	3	1	4	5	6	
	L	${f T}$	R	1	L	T	R	
Volume	19	504	28		9	342	15	
Peak-Hour Factor, PHF	0.75	0.87	0.63		0.68	0.87	0.70	
Hourly Flow Rate, HFR	25	579	44		13	393	21	
Percent Heavy Vehicles	3				3	~		·
Median Type/Storage	Undiv:	ided			/			
RT Channelized?								
Lanes	0	1	ο .		0	1	0	
Configuration	L'	rr			<u> </u>	ľR		
pstream Signal?		No				No		
								_
Minor Street: Approach	No	rthbound			Şoı	ıthbou	nd	
Minor Street: Approach Movement	No:	rthbound 8	i 9	ı	Sou 10	thbou	nd 12	
				ļ				
	7	8	9	ļ	10	11	12	
	7	8	9	ļ	10	11	12	·····
Movement	7 L	8 T	9 R	ļ	10 L	11 T	12 R	
Movement	7 L 54	8 T	9 R 15		10 L	11 T	12 R	
Wolume Peak Hour Factor, PHF	7 L 54 0.84	8 T 2 0.50	9 R 15 0.42	ļ	10 L 16 0.50	11 T	12 R 15 0.62	
Wolume Peak Hour Factor, PHF Hourly Flow Rate, HFR	7 L 54 0.84 64	8 T 2 0.50 4	9 R 15 0.42 35		10 L 16 0.50 32	11 T 3 0.75 4	12 R 15 0.62 24	
Volume Peak Hour Factor, PHF Hourly Flow Rate, HFR Percent Heavy Vehicles	7 L 54 0.84 64 3	8 T 2 0.50 4 3	9 R 15 0.42 35		10 L 16 0.50 32	11 T 3 0.75 4 3	12 R 15 0.62 24	
Volume Peak Hour Factor, PHF Hourly Flow Rate, HFR Percent Heavy Vehicles Percent Grade (%)	7 L 54 0.84 64 3	8 T 2 0.50 4 3	9 R 15 0.42 35 3		10 L 16 0.50 32	11 T 3 0.75 4 3	12 R 15 0.62 24 3	

Approach	_Delay,	Queue Le	ngth, and Level o	of Servi	ce
Movement	1	4	7 8 9	1 1	
Lane Config	LTR	LTR	LTR	1	LTR
v (vph)	25	13	103		60
C(m) (vph)	1140	953	225		240
v/c	0.02	0.01	0.46		0.25
95% queue length	0.07	0.04	2.21		0.96
Control Delay	8.2	8.8	33.8		24.9
os · · · ·	A	Α.	D		С
Approach Delay			33.8		24.9
Approach LOS			D		C

Phone: E-Mail: Fax:

TWO-WAY STOP CONTROL (TWSC) ANALYSIS

Analyst:

TR

Agency/Co.:

McMillen Engineering

Date Performed:

10/2/2005

Analysis Time Period: Saturday Base

Intersection:

Route 40/ Dinner Bell Road

Jurisdiction:

Units: U. S. Customary

Analysis Year:

2006

Project ID: Route 40 and Dinner Bell Road Intersection

East/West Street: Route 40

North/South Street:

Dinner Bell Road

Intersection Orientation: EW

Study period (hrs): 0.25

	Vehicle	Volume:	s and Ad	justmen	ts		
Major Street Movements	_ 1	2	3	4	5	6	
	. L	T	R	$\mathbf{L}$	T	R	
Volume	19	504	28	9	342	15	
Peak-Hour Factor, PHF	0.75	0.87	0.63	0.68	0.87	0.70	
Peak-15 Minute Volume	6	145	11	3	98	5	
Hourly Flow Rate, HFR	25	579	44	13	393	21	
Percent Heavy Vehicles	3			3		~-	
Median Type/Storage RT Channelized?	Undi	vided		/			
Lanes	0	1	0	0	1	0	
Configuration	L	rr		L	TR		
Upstream Signal?		No			No		
Minor Street Movements	7	8	9	10	11	12	
	L	Т	R	L	T	R	
Volume	54	2	15	16	3	15	<del></del>
Peak Hour Factor, PHF	0.84	0.50	0.42	0.50	0.75	0.62	
Peak-15 Minute Volume	16	1	9	8	1	6	
Hourly Flow Rate, HFR	64	4	35	. 32	4	24	
Percent Heavy Vehicles	3	3	3	3	3	3	
Percent Grade (%)		-4			3		
Flared Approach: Exists	s?/Storage	2	No	/		No ·	/
RT Channelized?	_		_	_	_	_	
Lanes	0	1	0	0	1	0	
Configuration		LTR			LTR		

Movements	Pedestrian 13	Volumes 14	and Ad	justments_ 16	
Flow (ped/hr)	0	0	0	0	

12.012.0 12.0 Lane Width (ft) 12.0 Walking Speed (ft/sec) 4.0 4.0 4.0 4.0

Per	cent Blockage		0	0	0	0			
			Uŗ	ostream Si	gnal Dat	.a			
		Prog. Flow vph	Sat Flow vph	Arrival	Green		Prog. Speed mph	Distance to Signa feet	
SZ	Left-Turn Through			April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 April 10 Apr					
\$5	Left-Turn Through								
Wor	ksheet 3-Data	for Con	nputing	Effect of	Delay t	o Major	Street \	Vehicles	
					· Movem	ent 2	Moveme	ent 5	
Sha	red in volume,	, major	th vehi	cles:	579		393		
Sha	red ln volume,	, major	rt vehi	cles:	44		21		
	flow rate, ma	_			180	0	1800		
Sat	flow rate, ma	ajor rt	vehicle	s:	. 180	0	1800	)	

1

1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Number of major street through lanes:

Critical	Gap Cal	culati	on						_
<i>lovement</i>		1	4	7	8	9	10	11	12
		L	L	L	T	R	L	${f T}$	R
(c,base	)	4.1	4.1	7.1	6.5	6.2	7.1	6.5	6.2
(c,hv)		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
(hv)		3	3	3	3	3	3	3	3
:(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
rade/10	0			-0.04	-0.04	-0.04	0.03	0.03	0.03
(3,1t)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage		0.00	1.00	1.00	0.00	1.00	1.00	0.00
(c)	1-stage	4.1	4.1	7.1	6.5	6.2	7.1	6.5	6.2
	2-stage	•							
ollow-U	p Time Ca	alculat	ions						
lovement		1	4	7	8	9	10	11	12
		L	L	L	Т	R	L	. Т	R
(f,base	)	2.20	2.20	3.50	4.00	3.30	3.50	4.00	3.30
(f, HV)		0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
(HV)		3	3	3	3	3	3	3	3
(f)		2.2	2.2	3.5	4.0	3.3	3.5	4.0	3.3

Worksheet 5-Effect of Upstream Signals

omputation	1-Queue	Clearance	Time	at	Upstream	Signal		
					том	rement 2	Мо	vement 5
					V(t)	V(1,prot)	V(t)	V(l,prot
								-

```
Total Saturation Flow Rate, s (vph)
 Arrival Type
 Effective Green, q (sec)
Cycle Length, C (sec)
 Rp (from Exhibit 16-11)
 Proportion vehicles arriving on green P
 g(q1)
 g (a2)
 g (q)
Computation 2-Proportion of TWSC Intersection Time blocked
                                                 Movement 2
                                                                     Movement 5
                                              V(t)
                                                     V(1,prot)
                                                                 V(t)
                                                                         V(1,prot
alpha
beta
Travel time, t(a) (sec) Smoothing Factor, F
Proportion of conflicting flow, f
Max platooned flow, V(c,max)
Min platooned flow, V(c,min)
Duration of blocked period, t(p)
                                                   0.000
                                                                       0.000
Proportion time blocked, p
Computation 3-Platoon Event Periods
                                            Result
p(2)
                                            0.000
p(5)
                                            0.000
p(dom)
p(subo)
 Constrained or unconstrained?
Proportion
unblocked
                                                (2)
                              (1)
                                                                 (3)
for minor
                         Single-stage
                                                 Two-Stage Process
movements, p(x)
                           Process
                                            Stage I
                                                              Stage II
p(1)
p(4)
p(7)
p(8)
p(9)
p(10)
p(11)
p(12)
Computation 4 and 5
Single-Stage Process
                                          7
Movement
                          1
                                  4
                                                         9
                                                                10
                                                 8
                                                                       11
                                                                               12
                          L
                                  L
                                                 Т
                                                         R
                                                                         T
                                                                 L
                                                                                R
V c,x
                                 623
                         414
                                        1095
                                                1091
                                                        601
                                                               1100
                                                                       1103
                                                                               40
Px
V c,u,x
  r,x
C plat,x
Two-Stage Process
                       7
                                        8
                                                         10
                                                                          11
```

	Stagel	Stage2	Stagel	Stage2	Stagel	Stage2	Stagel	Sta
V(c,x)								
S		1500		1500 ·		1500		150
P(x) .								
√(c,u,x)								
C(r,x) C(plat,x)		-						
Worksheet 6-Im	pedance	and Cap	acity Eq	<sub>[uations</sub>				
Step 1: RT fro	m Minor	St.	<del></del>		9		12	
Conflicting Fl	OWS				601		404	
Potential Capa					499		644	
Pedestrian Imp		Factor		•	1.00		1.00	
Movement Capac					499		644	
Probability of		free St.			0.93		0.96	
Step 2: LT from	m Major	St.		<del></del> .	4		1	
Conflicting Fl-				<del>- ,</del>	623		414	
Potential Capa					953		1140	
Pedestrian Imp		Factor			1.00		1.00	
Movement Capac		_			953		1140	
Probability of					0.99		0.98	
Maj L-Shared P	rob Q f:	ree St.			0.98		0.97	
'tep 3: TH from	m Minor	St.			8		11	
Conflicting Flo					1091		1103	-
Potential Capac					214		210	
Pedestrian Impe			_		1.00		1.00	
Cap. Adj. facto		o Impedi	ing mvmn	t	0.95		0.95	
Movement Capac		<b>-</b>			203		199	
Probability of	Queue 1	ree St.			0.98		0.98	
Step 4: LT from	n Minor	St.	<del></del>		7		10	
Conflicting Flo				<del></del> -	1095		1100	
Potential Capac					191		188	
Pedestrian Impe					1.00		1.00	
Maj. L, Min T 1					0.93		0.93	
Maj. L, Min T A					0.95		0.95	
Cap. Adj. facto		o Impedi	ing mymni	t	0.91		0.88	
Movement Capaci	.ty				174		166	

8

11

Part 1 - First Stage Conflicting Flows

otential Capacity

Pedestrian Impedance Factor

Step 3: TH from Minor St.

Cap. Adj. factor due to Impeding mymnt Movement Capacity

Probability of Queue free St.

Part 2 - Second Stage Conflicting Flows Potential Capacity Pedestrian Impedance Factor Cap. Adj. factor due to Impeding mvmnt Movement Capacity  Part 3 - Single Stage Conflicting Flows 1091 Potential Capacity 214 Pedestrian Impedance Factor 1.00 Cap. Adj. factor due to Impeding mvmnt 0.95 Movement Capacity 203  Result for 2 stage process:	1103 210 1.00 0.95 199
Conflicting Flows Potential Capacity Pedestrian Impedance Factor Cap. Adj. factor due to Impeding mvmnt Movement Capacity  Part 3 - Single Stage Conflicting Flows 1091 Potential Capacity 214 Pedestrian Impedance Factor 1.00 Cap. Adj. factor due to Impeding mvmnt 0.95 Movement Capacity 203  Result for 2 stage process:	210 1.00 0.95
Pedestrian Impedance Factor Cap. Adj. factor due to Impeding mvmnt Movement Capacity  Part 3 - Single Stage Conflicting Flows 1091 Potential Capacity 214 Pedestrian Impedance Factor 1.00 Cap. Adj. factor due to Impeding mvmnt 0.95 Movement Capacity 203  Result for 2 stage process:	210 1.00 0.95
Cap. Adj. factor due to Impeding mvmnt Movement Capacity  Part 3 - Single Stage Conflicting Flows 1091 Potential Capacity 214 Pedestrian Impedance Factor 1.00 Cap. Adj. factor due to Impeding mvmnt 0.95 Movement Capacity 203  Result for 2 stage process:	210 1.00 0.95
Movement Capacity  Part 3 - Single Stage Conflicting Flows 1091 Potential Capacity 214 Pedestrian Impedance Factor 1.00 Cap. Adj. factor due to Impeding mvmnt 0.95 Movement Capacity 203  Result for 2 stage process:	210 1.00 0.95
Part 3 - Single Stage Conflicting Flows 1091 Potential Capacity 214 Pedestrian Impedance Factor 1.00 Cap. Adj. factor due to Impeding mvmnt 0.95 Movement Capacity 203 Result for 2 stage process:	210 1.00 0.95
Conflicting Flows 1091 Potential Capacity 214 Pedestrian Impedance Factor 1.00 Cap. Adj. factor due to Impeding mvmnt 0.95 Movement Capacity 203  Result for 2 stage process:	210 1.00 0.95
Conflicting Flows 1091 Potential Capacity 214 Pedestrian Impedance Factor 1.00 Cap. Adj. factor due to Impeding mvmnt 0.95 Movement Capacity 203 Result for 2 stage process:	210 1.00 0.95
Potential Capacity 214 Pedestrian Impedance Factor 1.00 Cap. Adj. factor due to Impeding mvmnt 0.95 Movement Capacity 203  Result for 2 stage process:	1.00 0.95
Pedestrian Impedance Factor 1.00 Cap. Adj. factor due to Impeding mvmnt 0.95 Movement Capacity 203  Result for 2 stage process:	0.95
Movement Capacity 203  Result for 2 stage process:	
Result for 2 stage process:	100
·	133
a	
у .	
C t 203	199
Probability of Queue free St. 0.98	0.98
Step 4: LT from Minor St. 7	10
Part 1 - First Stage	•
Conflicting Flows	
Potential Capacity	
Pedestrian Impedance Factor	
Cap. Adj. factor due to Impeding mymnt	
Movement Capacity	
vomec oupsetel	
'art 2 - Second Stage	
Conflicting Flows	
Potential Capacity	
Pedestrian Impedance Factor	
Cap. Adj. factor due to Impeding mvmnt	
Movement Capacity	
Pant 2 Cinalo Ctara	
Part 3 - Single Stage Conflicting Flows 1095	7100
	1100
Potential Capacity 191 Podestrian Impedance Factor 1 00	188
Pedestrian Impedance Factor 1.00	1.00
Maj. L, Min T Impedance factor 0.93	0.93
Maj. L, Min T Adj. Imp Factor. 0.95	0.95
Cap. Adj. factor due to Impeding mvmnt 0.91	0.88
Movement Capacity 174	166
Results for Two-stage process:	
a <sup>,</sup>	
У	
У	166
y C t 174	166
Worksheet 8-Shared Lane Calculations	
Y C t 174 Worksheet 8-Shared Lane Calculations	10 11 12
Y C t 174  Worksheet 8-Shared Lane Calculations  Movement 7 8 9 L T R	10 1 <u>1</u> 12 L T R
Y C t 174  Worksheet 8-Shared Lane Calculations  Movement 7 8 9 L T R  Volume (vph) 64 4 35	10 11 12 L T R
Y C t 174  Worksheet 8-Shared Lane Calculations  Movement 7 8 9 L T R  Volume (vph) 64 4 35	10 11 12 L T R

## Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7	8	9	10	11	12
	· L	Т	R	L	${f T}$	I
C sep	174	203	499	166	199	64
Volume	64	4	35	32	4	24
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max			<del></del>			
C sh		225			240	
SUM C sep						
n						
C act						

# Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config LTR LT		LTR		LTR	LTR			
v (vph)	25	13		103		<del>-</del>	60	
C(m) (vph) .	1140	953		225			240	
v/c	0.02	0.01		0.46			0.25	
95% queue length	0.07	0.04		2.21			0.96	
Control Delay	8.2	8.8		33.8			24.9	
os	A	Α		D			С	
Approach Delay				33.8			24.9	
Approach LOS				D			С	

	Movement 2	Movement 5
p(oj)	0.98	0.99
v(il), Volume for stream 2 or 5	579	393
v(i2), Volume for stream 3 or 6	44	21
s(il), Saturation flow rate for stream 2 or 5	1800	1800
s(i2), Saturation flow rate for stream 3 or 6	1800	1800
P*(0j)	0.97	0.98
d(M,LT), Delay for stream 1 or 4	8.2	8.8
N, Number of major street through lanes	1	1
d(rank, 1) Delay for stream 2 or 5	0.3	0.2